Volume 14, No. 5

September • 1959

Forest Soils Survey

Alaska

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COVER: American people are now more receptive than ever to conservation programs. In the perception and the professional skills of soil and water conservationists there rests a great trust. A trust involving man, the land, and the future. This trinity can trend toward beauty. Or it can move in the direction of desolation. Is this the basic challenge of conservation?

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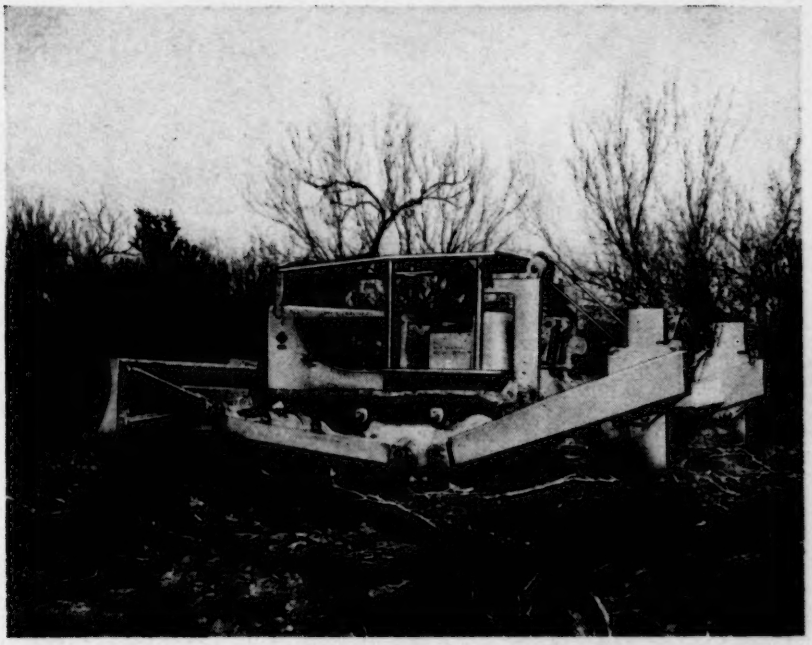

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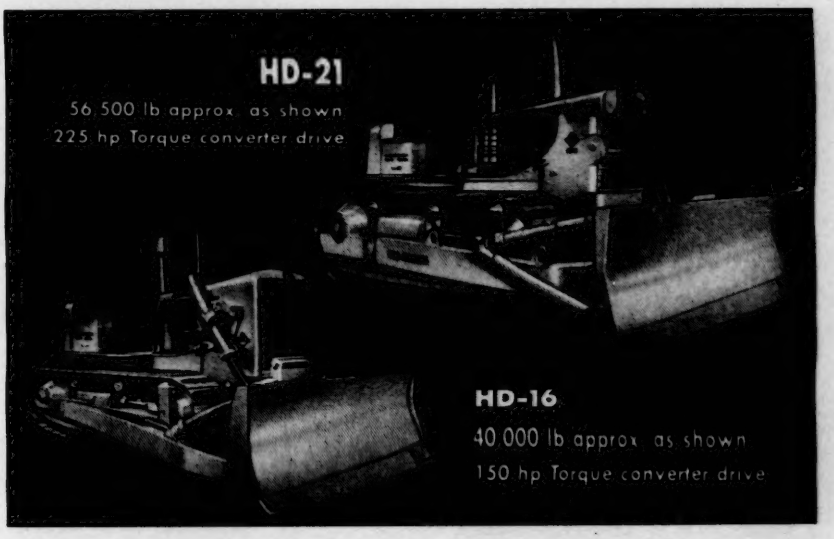

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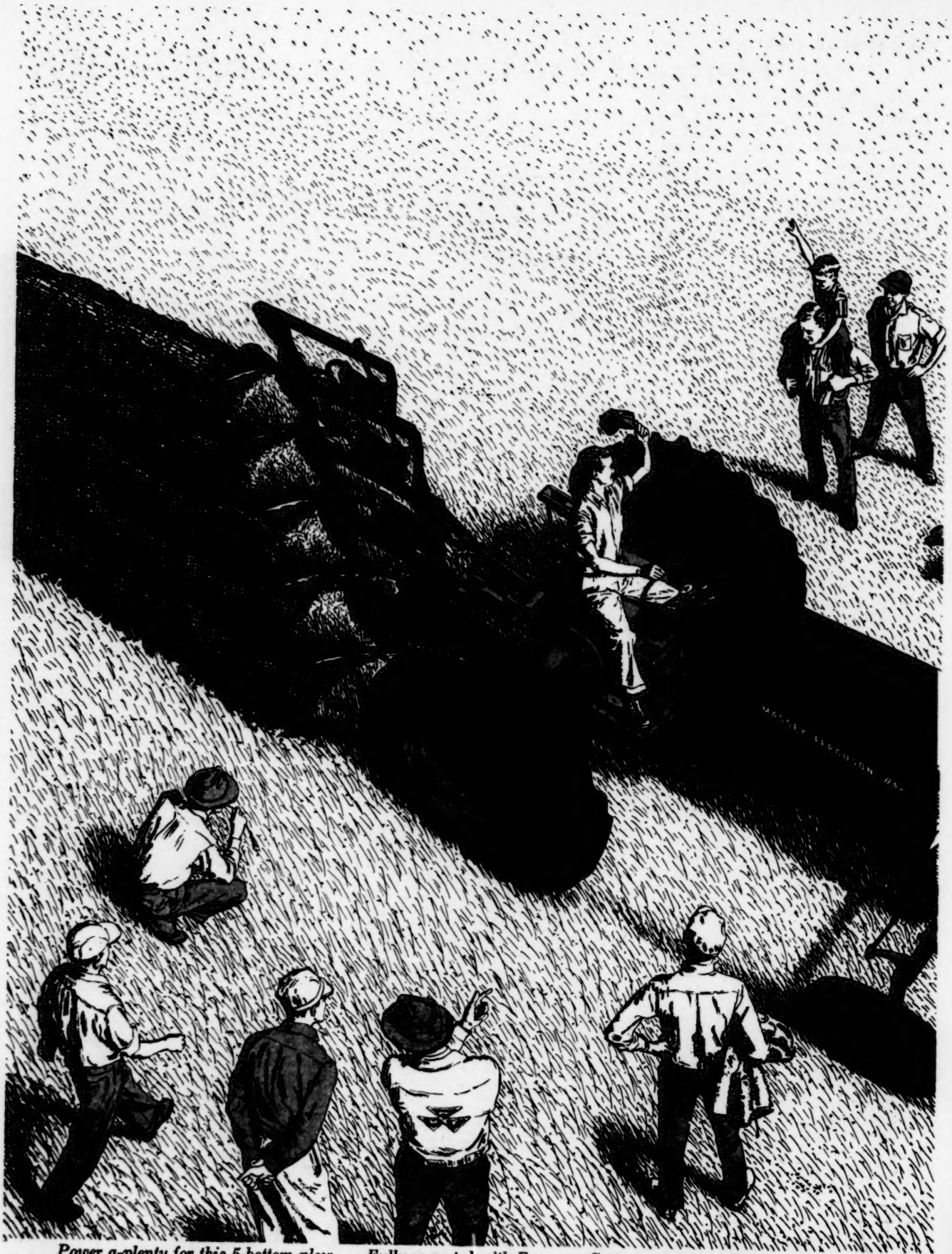

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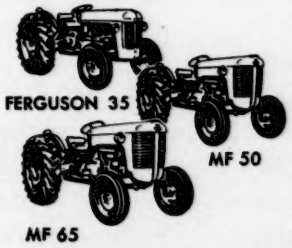

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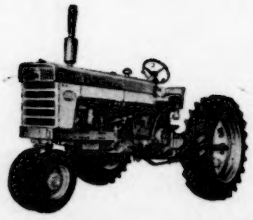
There are six Farmall®  power sizes

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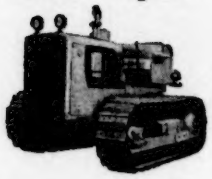
There are six International® 

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A Soil Survey of Forest Land

LLOYD E. GARLAND, ROBERT S. PIERCE AND GEORGE R. TRIMBLE, JR.

WITHIN RECENT YEARS there has grown a need for information about forest soils, information that can be used for management of forest land, not only for growing timber but also for managing watersheds and for wildlife and recreation. Soil surveyors all over the United States are beginning to examine and map more closely the soils of large woodland areas.

This has brought new problems to soils men and foresters alike. Noteworthy attempts have been made to develop forest-soil survey methods in various parts of the country. Best results have been obtained by foresters and soils men working together.

In 1955, the Northeastern Forest Experiment Station established the Hubbard Brook Experimental Forest for watershed management research. At that time no detailed soils maps were available for this 7,500-acre wooded valley in the White Mountains of New Hampshire. Using Hubbard Brook Forest as a pilot-study area, soils men of the U. S. Soil Conservation Service and research foresters of the U. S. Forest Service worked out the forest soil survey guides described here.

The topographic, soil, and geologic factors suggested for special consideration in these guides are by no means original, nor, taken one by one, are the methods new or different. However, in this study they were developed through simplification and screening into an approach particularly applicable to this section of the country. This approach is not recommended for other areas where conditions are radically different, such as nearly level areas in parts of the South where soils are deep and non-stony. Nor is it recommended for western areas where soil-vegetation survey methods have been developed. On the other hand, soil-vegetation surveys of the western type are not applicable in the Northeast where the type of *present* forest cover does not necessarily indicate soil or climate of a particular kind.

Natural Factors Influence Survey Procedures

Two basic types of information on land features and soils are needed particularly for the management of woodlands:

- Information is needed that will indicate the tree-growing potential of the area—the conditions that influence the growth rate of timber and determine the species of trees best suited to grow there.
- Information is needed on the features that affect watershed-management aspects of the region, such as streamflow characteristics, erosion potential, and water-storage capacities. This information is also needed to aid in planning logging operations and road construction, including the possibilities of finding sand and gravel.

Lloyd E. Garland is soil correlator (interpretation), Northeast Area, U. S. Soil Conservation Service, at Cornell University, Ithaca, New York.

Robert S. Pierce and George R. Trimble, Jr., are research foresters, Northeastern Forest Experiment Station, U. S. Forest Service, stationed respectively at the White Pine-Hardwood Research Center, Laconia, New Hampshire, and the Mountain State Research Center, Elkins, West Virginia.

When this study was made, G. R. Trimble, Jr., was on the FS staff at Laconia, New Hampshire, and L. E. Garland was on the SCS staff at Durham, New Hampshire.

Thus, in designing the Hubbard Brook Experimental Forest soil survey, the aim was to work out procedures that, within the limits determined by reasonable time and cost, would broadly define the tree-growing conditions and watershed-management aspects of any area of woodland. In addition, certain criteria were set up to indicate logging and road-building limitations.

The broad environmental factors that affect tree growth and water relationships are known. For purposes of discussion these can be divided into topographic factors, soil factors, and geologic factors. Large-scale climatic effects (as contrasted to those associated with topographic variations on a limited area) are not included because it is assumed that essentially they would be uniform for any mapping unit. The influence of individual factors is exerted largely through soil moisture. Insufficient soil moisture is probably the most influential factor limiting forest growth where permanent water tables are not accessible to tree roots (2, 3). Movement and storage of soil moisture, as affected by topography, soils, and geology, determine to great degrees the disposition of precipitation as streamflow.

Topographic Factors

Topographic factors that affect the timber-growing potential and watershed relationships include aspect, steepness of slope, position on slope, the arrangement of land masses in relation to each other, and elevation. Natural drainage conditions, even though they are often related to topographic position, are discussed under soil factors.

Aspect. Forest-site studies have shown that, in general, timber grows better on north and east aspects than

on drier south and west aspects, which receive more solar radiation. Watershed studies have shown that snow persists longer on north and east aspects, and that the timing of spring runoff is influenced decidedly by the proportion of an area in the different aspects.

Slope. Steepness of slope, while it appears to influence soil-moisture relationships less than aspect, does have an effect on timber growth. Einspar and McComb, working in northern Iowa, found that the growth rate of oak stands decreased with increasing slope per cent, and this effect was greater on southerly than on northerly aspects (4). Two phenomena appear to be involved here. First, soils tend to be shallower on steep slopes and therefore provide less water for growth. Second, in the northern hemisphere, on south slopes the steeper slopes receive a higher proportion of more direct sun's rays and thus more heat. On north-facing slopes the reverse relationship exists; gentle slopes receive more direct sunlight than steep ones. Slope also affects watershed relations: where slopes are steep and soils shallow, rapid rises in streamflow may follow heavy rainfall.

Position on slope. Where slopes are not long enough to receive substantially different amounts of rain and snowfall, the soil moisture supply of the upper slope generally is less than that of the lower slope. This is because the lower slope receives gravity water from the upper slope. Timber growth is better in moist coves and seepage spots, and these are found more frequently with increasing distance from the ridge top (Fig. 1).

Figure 1. A well-growing stand of timber on gentle lower slope with deep well-drained soil and a minimum of rocks.

Arrangement of land masses. The arrangement of land masses affects the wind currents and the amount of sunlight received. Auten (1) working with yellow poplar in the southern Appalachians, showed that timber growth on slopes sheltered from intense sunlight and/or prevailing winds by adjacent land masses is better than growth on unsheltered slopes having the same aspect. The pattern of snowmelt on southerly slopes may also reflect the shading of adjacent land masses to the south.

Elevation. This factor modifies both the moisture regime and timber growth since it affects temperature and precipitation. In some regions precipitation and temperature differences are reflected in a change in forest composition with a change in elevation; often the more southerly species found in mixtures on the lower slope of a high mountain may give way entirely to more hardy northern species near the top. In the White Mountains of New Hampshire, more precipitation falls as snow on the higher slopes than on the lower; snow comes earlier and stays later at the higher elevations. At the colder upper altitudes the growing season is shorter and evapotranspiration probably accounts for a lower percentage of precipitation. These relationships affect streamflow.

Soil Factors

Timber-growth and watershed relationships are influenced by many physical soil factors including texture, depth of bedrock, natural drainage, organic-matter content, and stoniness.

Texture. Soil texture influences the moisture storage capacity of the soil, the rate of water movement into and through the soil mantle, and the susceptibility of the land to erosion. Finer-textured soils (loams) hold more moisture at field capacity than coarse-textured soils (sands). Increasing fineness of texture is accompanied generally by an increase in timber productivity until the fineness restricts aeration in the root zone. Very fine-textured clays, especially montmorillonitic clays, which swell tight when wet, may be less productive than loams because of poor aeration.

Depth to bedrock. Bedrock close to the surface limits moisture storage capacities, restricts tree growth (Fig. 2), and influences the runoff characteristics of an area. Unless bedrock is highly porous and stores appreciable groundwater, streams in areas of shallow soils show quick rises during storms or periods of snowmelt. They also dry up quickly during dry periods. In some cases, depth of soil to a compact layer has an influence similar to depth to bedrock.

Drainage. The natural drainage characteristics of an area, whether determined by topographic position or conditions in the soil profile, are important in a number of ways. In the glaciated areas of the Northeast, natural

Figure 2. A stand of timber with short stems and poor growth on an upper slope with a soil depth of 24 inches or less to bedrock.

Figure 3. The rugged terrain of the Hubbard Brook Experimental Forest. Boulders and rocks tend to restrict logging operations.

drainage ranges from excessive to very poor. Growth is slow on areas with excessive drainage, and on very wet or swampy land. Drainage conditions may also exert a differential effect on different species. For example, white pine grows well on poorly (but not *very* poorly) drained sites where red oak or sugar maple usually cannot survive. Watershed relationships are affected by swampy areas that have little or no capacity to store additional water in the soil. Yet, where they lack a surface outlet, such swamps may have considerable capacity for temporary surface storage of rainfall or snowmelt. Excessive drainage may result from coarse sands overlying gravel beds which, in turn, may be excellent groundwater aquifers.

Organic matter. In the Northeast, where humus layers are well developed, the amount and nature of organic matter on or incorporated in the upper soil horizons has a very pronounced influence on soil moisture relations. Organic matter increases the water-storage capacity of the soil profile, especially in coarse-textured soils. In medium- and fine-textured soils it increases aggregation and improves soil structure, thus increasing the rate at

which water can move into and through the surface soil horizons. Organic matter on the surface protects the soil against the impact of falling raindrops, which can cause splash erosion and surface runoff. To the extent that organic matter improves soil structure, moisture relationships, and aeration (in fine-textured soils), it increases tree growth.

Stoniness. Because stoniness is difficult to measure, its effects on timber production and watershed characteristics have not been determined. A soil that contains large amounts of unconsolidated stone has less capacity to store water, supply nutrients, or provide root space than a stone-free soil. Productivity of shallow soils may be particularly limited by stoniness. The amount of surface stone can also affect logging operations, road building, erosion potential, and streamflow (Fig. 3). In boulder fields, small streams often flow underground or partially underground and channels rarely are well defined. Summer logging in boulder fields may be difficult, if feasible at all, and the cost of road-building in these areas is generally very great.

Geologic Factors

In the Northeast, knowledge of the bedrock geologic formation is often of little importance in making forest soil surveys unless groundwater characteristics are involved. For one thing, in most areas glacial material has a more important influence than bedrock. For another, the soil and topographic characteristics affected by geology are, in any case, noted independently.

The kind of rock formation affects the storage and disposal of underground water. A relatively tight and impervious rock formation, such as the schist and granite of the Hubbard Brook area, may have a very small water-storage capacity. The few shallow cracks in such a formation hold relatively little water so that in areas without free groundwater in the soil mantle, streams have scant storage to draw upon during dry periods.

Identification and classification of the surficial geology —in New Hampshire, the glacial deposits —is important. These glacial deposits are the material from which the soil is derived; and as such they help determine the characteristics of the soil. They also store and transmit underground water. For example, a tight glacial till will store little free water, but a deep bed of gravel will store a large volume.

Survey Procedures and Field Work

The degree of detail with which a survey is made will vary with the need for data, the complexity of the area to be mapped, the scale of the original base map, and the use to which the map will be put. As the information collected on the Hubbard Brook Experimental Forest was on a rather broad basis, the survey was considered an extensive or reconnaissance type of soil survey. The base map (aerial photo) scale was 4 inches to 1 mile, and the average size of the delineated areas was approximately 80 acres excluding poorly drained and organic soil areas. Later, detailed soils information will be obtained for specific research areas in subwatersheds within the Experimental Forest.

The basic mapping units in standard soil surveys are soil types and phases. In the generalized Hubbard Brook survey they were combined into undifferentiated groups. For example, soils derived from granitic glacial till, such as the Hermon sandy loam and the Waumbek sandy loam, were combined. Each group was fairly homogeneous in the physical soil properties important in water relationships, timber growth, and other factors significant to the management of the area. These physical factors as expressed in the soil-mapping unit are normally: texture, depth to bedrock, natural drainage, surface stoniness, slope gradient, and parent or underlying material. The mapping units in the Hubbard Brook survey were set up to reflect certain classes and subdivisions of the important physical factors. Inclusions of other classes and subdivisions, beyond the range set, are bound to occur where the delineations average about 80 acres. The combinations indicated, however, are considered significant for forestry purposes and are dominant for the particular mapping unit. These classes are discussed under each factor.

▶ *Texture.* The following texture-class separations were used:

Class	*General terms*
Gravelly sands and gravelly loamy sands	Very coarse
Sands and loamy sand	Coarse
Sandy loams and fine sandy loams	Moderately coarse
Very fine sandy loam to silt	Medium
Clay loam to clay	Fine

Soils found were practically all in the moderately coarse and medium texture classes so that only these two classes were shown on the soil maps.

▶ *Depth to bedrock.* Characteristics of the area seemed to suggest that two soil-depth classes be recognized: 0 to 24 inches and over 24 inches deep. On steep slopes and mountain tops, the soils averaged less than 24 inches deep and, except for areas of ledge outcrops, all other areas had soils that were considerably deeper to bedrock. A more detailed subdivision of soil depth may be needed for many other woodland areas in the Northeast.

▸ *Natural drainage.* The following drainage classes are mapped in New Hampshire by the SCS: excessively drained, somewhat excessively drained, well drained, moderately well drained, poorly drained, and very poorly drained. For forestry purposes, only the following combinations of drainage classes were considered:

1. Excessively drained and somewhat excessively drained.
2. Well drained and moderately well drained.
3. Poorly drained and very poorly drained.

Organic soils (very poorly drained) were mapped as a separate unit.

▸ *Stoniness or rockiness.* This involves detached rock or ledge outcrops large enough to affect logging or construction. (Small stones are included in the nonstony soil designation.) The classification developed was purposely broad to fit the extensive survey conducted.

1. No stones or boulders: few to no stones or boulders or not enough to affect logging operations.
2. Stony: enough to affect logging but not enough to severely hamper it.
3. Bouldery: enough detached rock or boulders to prohibit ground logging without a deep snow cover. Water storage and type of streamflow will be affected; that is, streams will spread out and run partially underground.

A classification based on the percentage of visible surface rocks of a specific size might be applicable for other areas.

▸ *Slope gradient.* Three slope classes were used: 0 to 15 per cent, 16 to 35 per cent, and 36 per cent plus. The

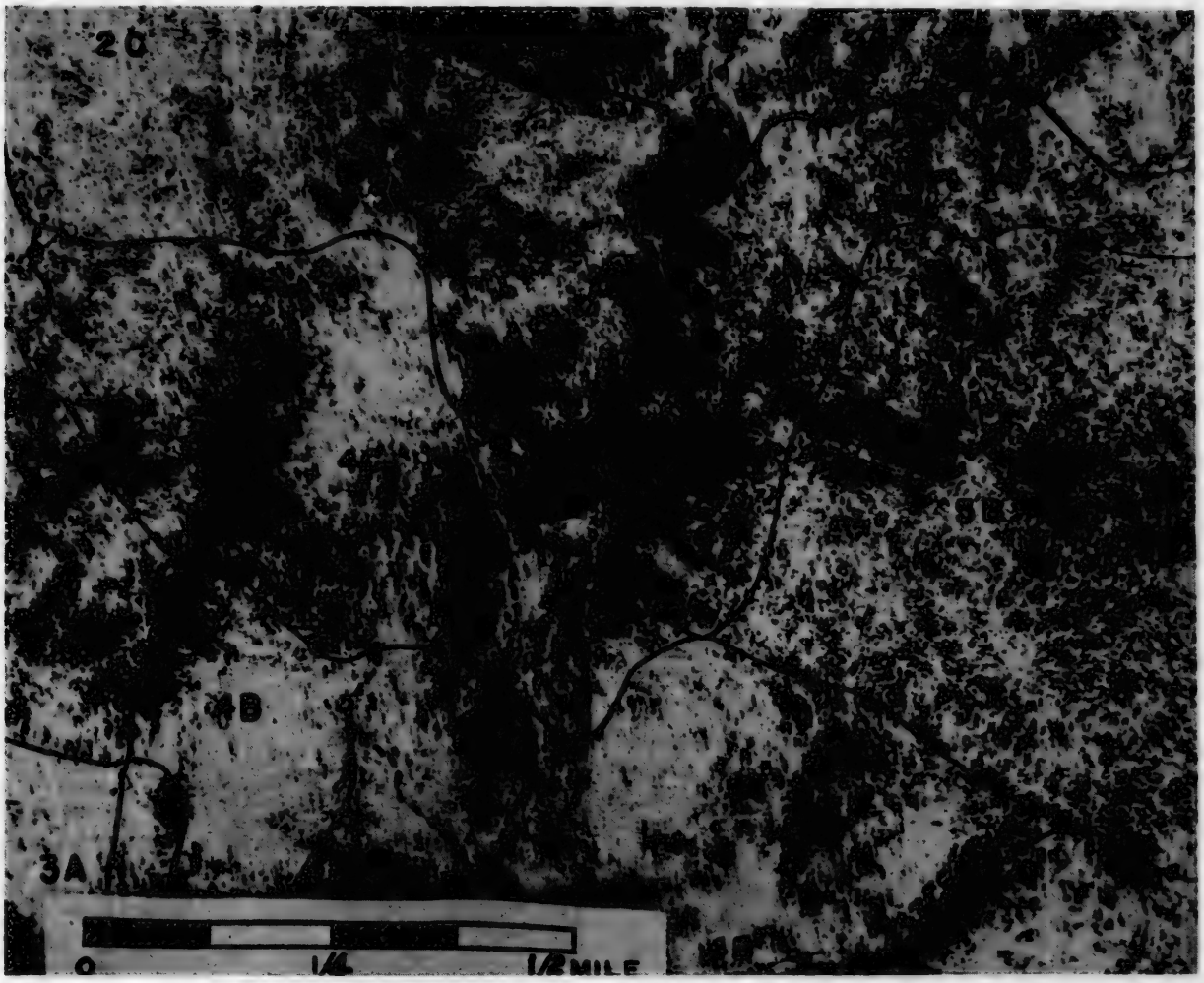

Figure 4. A section of the forest soil map prepared for the Hubbard Brook Experimental Forest. The symbols shown connote both soil name with the degree of slope. In "4B", for example, "4" indicates that the soil is Hermon and Waubek stony sandy loams; and "B" indicates a slope in the 16 to 35 per cent class.

Hubbard Brook Watershed has very steep topography. Slopes of less than 16 per cent would offer the best possibility for location of access roads, and slopes of more than 36 per cent would present serious difficulties in logging operations. The classes used on other areas would depend not only on the intensity of the survey but also on the actual topography. For example, an area with slopes between 0 to 30 per cent might be classed as 0 to 10, 11 to 20, 21 to 30 per cent.

▶ *Parent or underlying material.* For the Hubbard Brook Experimental Forest these were: Glacial till (granitic or schistose), glacial outwash, floodplain, and organic material (muck and peat). The soil-mapping unit descriptions indicate the nature of the parent or underlying material and define the particular soils that make up the undifferentiated soil groups and phases.

Description of mapping units. Soil-profile descriptions of the typical soils in the undifferentiated groups were obtained, and the range in their characteristics was defined. These descriptions will provide more complete knowledge on profile characteristics. The observations were taken according to standard soil-survey procedures, which involved digging a soil pit and describing each horizon in the profile (6).

Organic matter was described as to type and depth of the humus layers following the official humus classification adopted by the Soil Science Society of America (5). For most surveys, however, it will be sufficient to use only a few of the humus classes. For example, humus types may be grouped as follows: mor (organic material unmixed with mineral soil), and mull (where the surface soil or A_1 horizon contains a mixture of organic and mineral soil). A special type of mull designated "firm mull" (because it is compact and has a low organic-matter content) should be classified separately from the other mulls since it has a much lower infiltration rate. Humus type and depth data should describe average conditions within each mappable unit as determined from samples taken at several points.

After soil boundaries are shown on the map, it is an easy matter to determine from contour maps the aspect, position on slope, elevation, and exposure. With aerial photos alone, but with access to a stereoscope and planimetric maps, the job can be done, although not so readily. Where aerial photos and/or good contour maps are not available it will be necessary to identify in the field the important topographic features that relate to each mapping unit.

An illustration is given in Figure 4 of a section of the soils map of the Hubbard Brook Experimental Forest. Although land features such as aspect, position on slope, elevation, and exposure are not on this soils map, they can readily be determined from available aerial photographs and contour maps and shown on an overlay.

Discussion

This report presents a modification of detailed soil surveying methods on farmlands for use in mapping extensive areas of woodland in the Northeast. One reason for this modification is that certain aspects of forest soil surveys, such as type of mapping unit and degree of subdivision of the soil factors of texture, drainage, and per cent of land slope do not require mapping in as great detail as is used in mapping farmland.

On the other hand, information on such factors as aspect, position on slope, and exposure, which are not usually included in farmland soil surveys, are needed in surveys of forested areas to describe conditions affecting tree growth and watershed management. It is recognized that differences in these factors, while not reflected in morphological soil characteristics that can be identified in the field, do cause differences in soil-moisture relationships. In addition, there are temperature differences resulting from topographic factors. These differences influence evaporation and transpiration, and indirectly tree growth and streamflow, without producing noticeable soil differences.

Procedures for the Hubbard Brook survey are not set up as exact prototype procedures for forest land surveys in the Northeast. Objectives of the surveys may differ from one forest tract to another. For example, on a small accessible woodlot intensively managed for wood products, both soil and topographic features might be mapped in considerable detail. Good aerial photographs and good contour maps may not be available for an area of forest land, in which case it would be necessary in the field to indicate on an overlay the slope positions and aspects. Then, too, the ranges of the important factors may be greater or less than at Hubbard Brook. For example, in an area where bedrock lies between 2 and 50 feet below the surface the 0 to 24 and 24 inch plus classes used in this survey would be meaningless. Thus in all cases, to obtain the most useful survey, the actual procedures and classification details must be tailored to the needs of the area in question and the intensity of management expected to be practiced.

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Alaska, Agriculture and Adventure

HUGH A. JOHNSON

ALASKA has made news more and more frequently in recent years—primarily as a defensive base against attack from across the polar regions and lately for its gallant fight to achieve statehood.

Alaska is a fascinating phenomenon, vast, distant, largely unknown—abundantly endowed with legends. It has a romantic aura derived through the poetic license exercised by writers and the thought it is America's Last Frontier. Press releases usually mention its undeveloped resources and an anticipated boom of settlement.

Alaska seldom means exactly the same thing to two people for the same reasons. After living there for six years and studying its problems for several more, I have begun to realize the difficulty of *telling* anyone about Alaska.

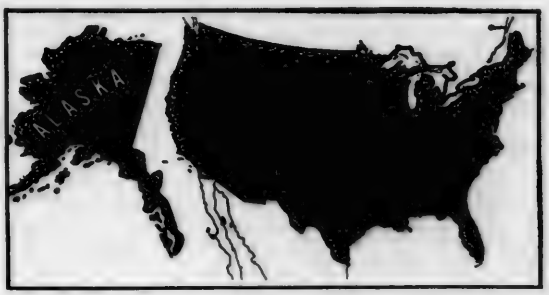
* * *

How does one talk about a land mass of 586,400 square miles and 365 million acres? Alaska stretches into four time zones. It reaches across 38 degrees of longitude and more than 15 degrees of latitude. It has a climatic range of temperatures and rainfall, variations in topography, and differences in vegetation greater than for most areas of comparable size in the 48 states (1).

The distance from Barrow to Ketchikan is comparable to that from Boston to Baton Rouge or from Washington, D. C., to Denver. My two sisters and I, in Texas, Illinois, and Virginia, respectively, are closer together than a resident of Nome, Alaska, is to his state capital; 90 per cent of Alaskans live more than 700 miles away from their government in Juneau. Many are days distant from a store, a doctor, or a traffic light.

Hugh A. Johnson is an agricultural economist in the Farm Economics Research Division, Agricultural Research Service, Washington, D.C. He brings to his subject a broad academic and experience background in land economics and farm management. He went to Alaska in 1949 to establish and develop a department of agricultural economics at the newly revitalized Agricultural Experiment Station of the University of Alaska. During his more than 6 years in this capacity he was active in community affairs, interdisciplinary scientific development, and was Experiment Station editor for one year, in addition to extensive research and administrative responsibilities. He was president of the Alaska Division of the American Association for the Advancement of Science during 1954.

Mr. Johnson has written many reports about Alaska, the latest being a chapter in LAND the 1958 Yearbook of Agriculture. He began a detailed study of Alaska's resource potential while at Harvard University in 1955-56 as a Littauer Fellow taking advanced courses in public administration and economics. This project is being completed currently under a grant from The Conservation Foundation.



How can one describe a frontier area whose roughly 220,000 residents are largely urbanites, cosmopolitan, well-traveled and modern, yet live surrounded by wilderness? How describe a people whose traditional frame of mind protects personal rights and freedom, yet whose lawmakers have led the way in adoption of social legislation? Can one explain the incongruity of modern shopping centers, skyscraper hotels, and log cabins in the same block; shopping by plane and dog team; or irrigated agriculture in a land so far north?

Alaska is a peninsula jutting out westward from Canada's British Columbia and Yukon Territory. Few people realize that parts of it are west of Hawaii or that less than a third of it is an Arctic area. Geologically, Alaska has three major physiographic provinces: Pacific Mountain, Central Plateau and Northern, with distinct differences in vegetative cover, climate, drainage, and living conditions.

Research and demonstration by individuals and government have shown that Alaska has a surprising potential for food production. Its magnitude is unknown, its possibilities largely untapped, and its problems largely unsolved. The old way of life is nearly gone and descendents of the aboriginal occupants must be assimilated into the new Alaska—the 49th State.

Alaska is a true frontier. Physically, it is on the margin of modern settlement; economically, many of its known natural resources are marginal under present industrial processes and the demands of our technological system. Socially, it is a melting pot, in which some native ways are found good, many "foreign" practices and mores are introduced, and new systems are developed and adapted. Defensively, Alaska is an outpost—an ear cocked for enemy movement and a missile aimed at enemy force. Scientifically, Alaska is a challenging array of new problems in every field—a laboratory that provides new conditions and can supply new answers as research pushes ahead on all fronts.

Agricultural Potential

Ideas differ as to Alaska's potential for agricultural production. Early travelers and experiment station personnel claimed that there were 300 to 400 million acres suitable for cultivation. Ten years ago, several of us thought that from 1 to 3 million acres was more nearly an accurate guess of the acreage physically, though not necessarily economically, suitable for agriculture (2). Since then, I have begun to liberalize my estimates upward.

These differences, of course, exist only because we lack adequate knowledge of soils, weather, and crop adaptability. The early explorers were able to observe only sections along the streams and trails—which traversed the best-drained areas and thus presented an optimistic face for judgment. Later, as we began flying across drainage basins and could see a mosaic of the countryside, we were impressed by the standing pools of water, the permanently frozen soils, and the stunted vegetation.

Recent research and demonstration, however, have shown that the soils of some areas will dry out and become productive once their insulating vegetative cover has been removed. New varieties and strains of crops are being developed for Alaska, and we are learning more about how to fertilize, irrigate, harvest, and store the crops we want to grow. Thus, the frontiers of science probably will have added to the agricultural frontier several million acres, if or when we need the products they can support.

Problems of Frost

Before we leave the subject of permanently frozen ground, perhaps I should tell you more about it. The principles of management are remarkably simple, but it took years to discover them. All of them center around heat transfer. If construction engineers want to maintain a solid base in the north, they now *add* insulation to preserve the frozen status of the ground. Conversely, if farmers clear off this insulation, the frozen soil melts, the excess water drains away, and the cleared area dries out.

Some of the early clearing trials were unsatisfactory because large windrows of debris were scraped to the edges of the clearings where some lay across hidden or undeveloped natural drainageways. The resulting insulation prevented thawing, and the frozen ground made a perfect dam. Surplus water from the thawing field had no place to go and the result was a muddy mess. Removal of the windrows allowed adequate drainage, and productive fields could be developed.

Still later, we learned that conservation farming of these soils was necessary to maintain productive humus levels and soil tilth as well as to prevent wind erosion. Water erosion can be a problem, also, although usually slope is slight on the fields of this kind of soil cleared so far.

Another unique icing condition occurs in some other Alaskan areas. This is the location of solid blocks or ice lenses under a soil mantle. They may have been deposited by glaciers but more generally they resulted from water seeping into cracks in the ground where it froze, caused larger cracks that made room for more water which froze, and so forth. These ice lenses are hard to detect before the land is cleared. Fields may be tilled for several years before they start to melt. Eventually, soil compaction or an unusually warm spell allows heat to penetrate to the ice. Sometimes only slight depressions occur as small blocks of ice melt but in extreme instances, fields become too rough for further use and are abandoned.

Geologists and soil surveyors have developed methods that help them locate areas in which ice lenses probably occur. At least two areas proposed for agricultural settlement have been abandoned partly because of prevalence of submerged ice (3). Settlers near Fairbanks also have guides as to where lenses are likely to occur. These areas can be eliminated from clearing plans and efforts concentrated on locations free from this risk.

Some Facts of Homesteading

For the time being, it doesn't matter whether Alaska's potential is for 1 million or 10 million acres of cropland. We already know that far more exists than will be needed during the next several years, that agricultural practices can increase production potential on the areas presently known, and that Alaskans are shipping in many tons of food that could be produced locally (4).

Settlers began farming in Alaska about 50 years ago. Markets were small, transportation was difficult, and farming conditions were primitive. Most settlers developed a subsistence economy, worked for wages when they could, sold a little produce, and cleared land as they had the time.

Southeastern Alaska, which lies in the moist and mountainous Pacific Mountain geological province, at one time had several dozen homesteads and fur farms, but the isolation, the limited area suitable for farming, and the general economic stagnation forced all except a handful to give up. The Kenai Peninsula farther north also had several large fur farms that failed eventually because fur prices dropped and production costs rose.

Homesteaders originally located in the Matanuska Valley, of the Pacific Mountain province, and in the Tanana Valley of the Central Plateau province, primarily to furnish feed for horses used to freight supplies to the

mines. Settlement expanded when the Alaska railroad was built and declined again when industrial development failed to follow. The Alaska Rural Rehabilitation Project, which moved 200 families to the Matanuska Colony in 1935, brought a small measure of prosperity to that area (5, 6). Although about half the land in the project was purchased from previous homesteaders, the additional capital investment meant additional activity to the local economy. Farming declined during World War II because the men could make good wages in the construction field.

Modern Alaska began to emerge after Japan was defeated and the Soviets developed as our real threat. The decision was made that Alaska should become a military base for continental defense. Millions of dollars were allocated for construction of bases, airfields, and highways, and for northern research. This program required labor, housing, and services. Many veterans who had served in Alaska wanted to homestead and be independent. Special educational and homesteading provisions in veterans' legislation after the war focused widespread attention on Alaska.

The multiple incentives caused a homesteading boom that placed a preponderance of desirable agricultural land in the hands of people ill-equipped for farming and created many problems still unsolved. Among these, the scattered settlement and the lowered levels of living for young families probably are the most serious.

The best lands near Fairbanks and in the heart of the Matanuska Valley had been settled before the postwar rush began. As a consequence, the veteran's choice lay between lands lying on the edges of established settlements relatively near markets and other facilities, on less desirable lands within settlements, or in new areas. A few who homesteaded near Anchorage and Fairbanks were able to subdivide in a few years as these cities expanded. Others who located farther out, developed small profitable farms or took jobs and became part-time farmers or rural residents.

The government was interested in prospects for a colonization project similar to the Matanuska Colony on the Kenai Peninsula; it concentrated its planning attention on the possibilities of that area. Many veterans took this interest to mean that future growth would be in this direction and located homesteads here. A highway was built to connect Anchorage with the length of the Peninsula, but hopes for a settlement project fell through and agricultural development stagnated.

Homestead abandonment following the postwar boom has been high. This was inevitable. Too many of the veterans had no farming experience, and most lacked the financial means required to develop a farm even if a market had been available for the products they might have grown. Too many of these young people learned from hard experience that productive land is not free, that the raw homestead is a far cry from the finished farm. Too many had come north in a fantastic fog of preconceptions that included idealized living by trapping, hunting and fishing.

Free land is a small bargain, indeed, if one lacks the money, equipment, and knowledge required to develop the resource. Land has value only as it has use; and the only kinds of agricultural uses that will pay for development require intensive commercial management. Rural residential and part-time farming uses require locations near employment and near roads rather than large areas of productive land. Speculation in land requires a rapidly rising demand for a limited resource—hardly a bright prospect today in view of looming imposition of real property taxes, land use planning and zoning regulations, penalties for nondevelopment and other controls available to the new State government.

A study of land settlement made on the Kenai Peninsula in 1955 showed that 59 per cent of all land entered or patented to that time was unoccupied and abandoned (7). Another 31 per cent was used solely for rural residences by persons who had no intention of farming. This left only 10 per cent of the homesteaded land occupied by persons farming or intending to farm. Only 1.3 per cent of the occupied land was cleared cropland—and nearly half of this had been cleared since 1950.

The Kenai Peninsula story was repeated with variations in the Matanuska and Tanana Valleys. In fact, although 2,155 homesteads had been patented by June 30, 1954, and a similar number were entered and occupied but unpatented, there are roughly 350 full-time farms in all of Alaska and another 350 that might be regarded as part-time or nominal farms. Many of these farmers are hard-pressed to support themselves.

The trend toward wholesale land abandonment was halted by a vast program of oil and gas exploration. Nearly 20 million acres have been leased from private owners and the government. Two oil wells of commercial volume have been drilled on the Kenai Peninsula, and exploration continues in several areas throughout Alaska. Opportunity to lease their raw undeveloped lands has been a boon to resident and non-resident owners alike. The fact that most titles issued before 1956 include subsurface mineral rights makes them more valuable. Both the State of Alaska and the Federal Government now reserve mineral rights to lands homesteaded, sold, or leased in sections where oil and gas exploration is likely to occur (8).

Passage of statehood also has encouraged owners to hold their land. Most Alaskans expect population to increase rapidly and industry, trade, and business to grow into several new fields in which men, materials and farm products can be utilized.

Although Alaska is a frontier, its present and its future differ greatly from those of the Midwest, the Great Plains, and the Northwest when they were settled. Alaskan farmers cannot expect to find an export market for surplus products. A possible exception to this rule would be to develop special types of production for trade with Asiatic countries, particularly Japan and Korea. This prospect appears to be remote.

It seems that the best Alaska can hope for is to capture more of its growing local market for adapted farm products. Serious question exists as to whether, under present conditions, the exotic values of homesteading as a way of life are worth the social cost involved.

Alaska presents many new physical production problems. Most of the areas suitable for settlement are timbered. Land clearing, land breaking, root picking, and tillage are expensive and time-consuming. Settlers often have from $100 to $200 or more per acre invested in cleared land. The growing season is short, and it waits for no man. The cool climate, the effect of low temperatures and light intensity on plant growth, the need for regular fertilization of crops and for efficiency in production must be taken into account when planning the new farm enterprise.

Soil and Land Classification

Recent study by soils specialists has resulted in new concepts about Alaskan soils. I am indebted to Roy Simonson of the Agricultural Research Center at Beltsville for data on the new classifications.

Three of the seven main soil groups in Alaska are of greatest immediate economic interest. Subarctic Brown Forest soils now support most of the agriculture and seem to have most promise for the future, together with Podzols and certain Alluvial soils. Soil groups with limited possibilities are Lithosols, Tundra soils, Bog soils, and Ando soils. Of these four, the first two have little or no potential, whereas the last two have limited possibilities.

Geographic distribution and characteristics of the Subarctic Brown Forest soils, Podzols, and associated well-drained Alluvial soils make them more promising than other groups for agricultural development. These soils occur mainly in the Matanuska Valley, the Kenai Lowland, and around Fairbanks, where they were formed from predominantly silty sediments. All are acid, and all are relatively low in plant nutrients. Lime requirements are low to moderate, but substantial applications of fertilizer are necessary. Under high levels of management, all of these soils can be productive.

The limited agricultural potential of many Alaskan soils is due to one or more causes. Lithosols, which are dominantly mountainous, are too shallow, steep, and stony. Tundra soils occur where temperatures are low and growing seasons short. Moreover, they are underlain by frozen ground and are generally wet. Bog soils (peat or muskeg) and Alluvial soils in the Tundra region share the unfavorable climate. Furthermore, Bog soils are limited in potential by slow warming in the spring and severe problems of water control. Similar difficulties exist in using the wetter areas of Alluvial soils. Ando soils (formed from volcanic ash) are largely restricted to parts of Kodiak Island, the Aleutian Islands, and the Alaska peninsula, where climate or topography, or both are unfavorable.

Tundra soils and Lithosols are much the most extensive in Alaska. Bog and Alluvial soils are widely distributed but are not of large acreage. Subarctic Brown Forest soils are of widespread occurrence but of modest extent. Podzols and Ando soils are restricted in both acreage and distribution.

Several studies of Alaska's soils have been made in areas most likely to warrant development. The U. S. Department of Agriculture has supported a series of demonstration and experimental farms at various locations for nearly 60 years. Stations like the one at Rampart on the Yukon River proved that crops could be grown satisfactorily at least that far north. Several were abandoned after they had demonstrated productive possibilities of the area and it became evident that population growth would not occur near there.

Hugh H. Bennett made the first Alaskan soils reconnaissance survey in the Matanuska Valley in 1914 and with Thomas D. Rice looked over parts of the Kenai Peninsula in 1915 for the former Bureau of Soils. The Soil Conservation Service sent special soil survey parties into Alaska during 1939 and 1940. Charles E. Kellogg and I. J. Nygard studied potential agricultural soils in 1946 as part of an overall exploratory agricultural task force (2).

After the Territorial Legislature created the Alaska Soil Conservation District in 1947, the Soil Conservation Service established a territorial (now State) office in Palmer.

An essential bridge between conservation needs, land-clearing practices, and farming methods is provided by SCS technicians who work closely with the settlers, advanced farmers, wildlife interests, the military, and other government agencies (9).

The Bureau of Land Management had classified on a reconnaissance basis about 1.5 million acres relative to its apparent suitability for agriculture by 1954. Of this total, more than 700,000 acres was vacant, unappropriated, or unreserved public domain available for settlers. Nearly half of this, or 336,000 acres, was thought to be cultivable. This proportion was reasonably close to the detailed soil surveys conducted by the Soil Conservation

Service in cooperation with the Experiment Station and the Bureau of Land Management. Of the more than 2 million acres mapped under this program in the Matanuska Valley, Anchorage, Kenai Peninsula, Fairbanks, and Big Delta areas, roughly 35 per cent has been of land-capability classes II or III quality, and about 10 per cent has been class IV land. Thus, somewhat less than half of the acreages in the best areas of Alaska are considered to be *physically* suited to some type of cultivation. A good bit of this lies scattered in small blocks, which are interspersed with untillable areas.

Relatively few settlers can get farm units of economic size from one homestead limited to 160 acres of all land qualities. A dairy farm of 30 cows, or a grain farm, would need more than 300 acres of average soil quality distribution to be assured of the 100 to 150 acres needed for cropping. For this reason, many people hope that the new State Division of Lands in the Department of Natural Resources will develop a sales or lease program that will break away from limitations of the homestead law philosophy.

Patterns of Growth Related to Agriculture

Alaska must select nearly 104 million acres from Federal public domain during the next 25 years. It will need to develop a broad gauge plan that will utilize and still conserve natural resources. It will need a rapidly growing local economy to support costs of government. Efficient and profitable industry, increasing trade, and growing service occupations are parts of this pattern. Agriculture has made slow progress to date because there were few other major enterprises to support populations that would buy farm products. Farming must be carried on as a supplement or complementary to other economic activities.

Alaska's population rose from 72,524 in 1940 to 128,643 in 1950 and 214,000 in 1958. Agriculture lagged behind population growth because time is required to get land into production. The 1950 census showed 6,450 acres harvested, 3,586 acres idle or without a crop, and 2,449 acres of cropland pastured. The acreage harvested had increased to 8,123 acres by 1953 and to 15,743 acres in 1957 from a total cleared acreage of a bit more than 20,000 acres. Estimates for 1958 show 17,085 acres harvested as cropland from a total of 21,515 cleared acres (10).

The value of farm products sold was estimated at $1.6 million in 1949. This rose to $2.7 million in 1955, to $3.3 million in 1957, and to $3.4 million in 1958.

As the market has grown and indicated that it might be permanent, many farmers have cleared additional land and developed dairy herds. A small market developed for surplus hay, and during the last 2 years, a small tonnage of grain was offered for sale in both the Matanuska and Tanana Valleys.

In 1958, about 350 families were depending entirely on farming for their livelihood. Of these, probably about 200 had enterprises sufficiently large to provide incomes comparable to average nonfarm wages. A few beef and sheep ranches were located on the islands and on parts of Kenai Peninsula. Another 500 to 700 part-time and nominal farms (on underdeveloped homesteads) were in varying stages of development. Operators of few of these sold appreciable quantities of produce and probably upward of three-fourths will never develop farms.

In 1958, sales of milk accounted for half of the commercial production, potatoes for a fifth, poultry products for an eighth, vegetables for a tenth, and animal products for the remaining eighth. The Matanuska Valley-Anchorage area accounted for 65 per cent of commercial farm production, the Tanana Valley-Fairbanks area for 15 per cent, southeastern Alaska for 8 per cent, and the Kenai Peninsula and Kodiak-Aleutians for the remaining 12 per cent.

Types of farming vary by regions and within regions according to the degree of individual farm development. The pattern in the Matanuska Valley appears to be the most advanced. Dairying predominates and probably it is the climax type of farming for this section. It is followed in importance by potato, poultry, vegetable, and mixed or general small farms. Few operators have developed the size, scale, and efficiency of operation required for the long pull against intense competition from "Outside" for the local markets.

The Tanana Valley probably will develop into a region largely self-sufficient in milk, eggs, feed grains, forage, potatoes, and acclimated truck crops. It may sell feed grains to farmers in the Matanuska Valley, Kenai Peninsula, and other regions as they develop. Also, it may develop grain production for flour mills and a brewing industry. In 1959, however, less than 40 families depended entirely on farms for income. Most of these were potato or vegetables farms. A few were dairies or poultry farms. The rest of the 100 or so homesteaders depended on nonfarm income while they cleared land and grew small acreages of potatoes, truck crops, or grain.

Development on the Kenai Peninsula has hardly started despite the heavy earlier interest in homesteading. Anchorage, the nearest large market, is almost too far away. Construction work and service to the oil-exploration crews have provided better alternatives than farming in recent years. Only a couple of farms were sufficiently well-developed to support a family adequately. Beef enterprises predominated, followed in order by poultry and dairy. Greenhouse, potato, and truck enterprises were found among the part-time group of operators. A visit to this region during 1958 seemed to show even less interest in farm development than there had been previously.

The Kenai Peninsula has areas eminently suited to farming when demand develops for its products. Generally, grassland farming is indicated for the Homer sector and row crops for the Kenai-Kasilof area. In general, the cool, damp climate will prevent extensive culture of small grains on the Peninsula.

Kodiak and the other westward islands are best suited to range livestock and wild game (11). Beef and sheep enterprises already are established on several leases and others are under consideration. Major problems concern transportation because there are few suitable harbors, markets are small and scattered, and the provision of stored feed to supplement forage available during winter and early spring is difficult.

Southeastern Alaska has fewer farm enterprises than formerly. Areas of suitable soils are very limited and generally poorly located in relation to potential markets. This is not farming country, although a few hardy families manage to provide examples to disprove the rule. I have noticed a definite increase in the number of lawns and small family gardens during the last 10 years owing, no doubt, to the excellent extension program. However, commercial agriculture has not increased.

Eventually, several other outlying areas of the interior undoubtedly will be developed to provide local farm products for new communities developed nearby. Climate and soil deficiencies will not prevent such development, although no sign now shows where this will be or when it will happen.

Supply and Demand

Even though Alaska today produces only 15 to 20 per cent of the foods it could provide locally for its present small population, active encouragement of further homesteading would be unwise. More and more Alaskans are beginning to share this view. The reasons for this conservatism in the face of vast undeveloped areas are based on economic facts.

Some years ago, I developed a supply and demand ratio that all of the feed for livestock and food for human consumption suited to Alaskan conditions could be grown on about ¼ to ⅓ acre of cropland per consumer at current rates of production and consumption (4). Thus, if Alaskans adopted a firm policy for using homegrown products to the maximum, a population of 100,000 people would support *at the most* only 33,000 acres of cropland and probably this would run closer to 20,000 acres in practice. Assuming that the average of all farms requires 100 acres of cropland to return an income comparable to that from nonfarm wages, this means that from 200 to 330 commercial farms only could be supported adequately by the population of 100,000. Actually, competition from "Outside" will mean that Alaskan farmers cannot sell all the adapted foods they can produce, and the number of farms that can be supported will be reduced accordingly—probably by nearly half.

Few of Alaska's struggling farmers have their farms fully developed as yet. Production on the present farms classed as full-time commercial probably could be doubled before full and efficient use of the land they contain would be realized. In addition, several hundred families have partially developed farms and need opportunity to complete their clearings, add lands to round out economic-sized units, and approach modern farming efficiency. Public expenses per capita for roads, schools, and police and fire protection, together with the social costs of unduly scattered settlement can be reduced significantly through guiding new development into relatively compact communities.

There are many opportunities to buy partially developed farms or raw land if one wants to farm in Alaska. The present market is far from saturated with local products and it promises to grow in the years ahead. But, if Alaska—or the United States—owes anything to potential settlers, it is the provision of a sound, growing, socio-economic system. This system must be built on lessons from the past, both the bitter and the sweet.

Bitter experience in Alaska, unfortunately for many would-be pioneers, has highlighted several lessons:

- Economic development cannot occur without products, a market for products, and people to provide the products.
- Alaskan agriculture currently is confined to the Alaskan local market; and to the share of that market it can "rassle" away from "Outside" producers and distributors.
- Families who depend on farming for their sole livelihood must be efficient managers. They must use modern methods, modern machines, and modern sizes of enterprise. Even subsistence farming requires considerably more cash business than is usually recognized. This trend is evident to farmers in the 48 "Outside" states. Alaskans must overcome even more stringent economic limitations.
- Part-time farmers and beginners will face increasing economic difficulties because of the strong competition from the larger, more efficient, better established, older, specialized farms.
- The volume of farm sales can be increased only as demand for local products is increased. Public relations, education, and other sales techniques have lagged behind quality control in the marketing field and production efficiency on the farms.

* * *

The picture of Alaska I have tried to draw for you is not meant to be gloomy. Alaska is certain to grow and agriculture to grow with it. How far or how fast either

will expand is anyone's guess. The message I wish to leave with you is that there is a hard core of reality lying below the fluffy facade of romanticism about the 49th Star.

Alaska will be Land's End for the chosen few who want the kind of life it has to offer. It will be a disappointment to the many who expect too much or those who are not willing to help build their own lives close to nature, working with the elements, and using but conserving resources. Alaska is a challenge to the best that is in all of us.

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Establishing Grass Waterways

HARRY L. PORTER, JR.

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ESTABLISHING and maintaining adequate vegetation in outlet channels is one of the difficult problems in soil conservation work in the Northeast, particularly in the fragipan soil area of New York and Pennsylvania. Specific parts of the problem involve: (1) High lime and fertilizer needs, (2) slope conditions from steep to moderate with many long slopes, (3) continuous seepage in the spring and during wet periods, (4) after channel construction there is little or no permeable soil above the fragipan, (5) soils become hard and "baked-out" during dry periods, (6) stony, hard soils make smooth construction difficult, (7) the standard waterway mixture of Kentucky bluegrass and redtop widely used in the Northeast, is slow in getting started and is not well adapted to these conditions.

Research work at Stillwater (Oklahoma), McCredie (Missouri), and Spartanburg (South Carolina) provided some guides for the channel design and types of vegetation to use, and reveals some basic principles about the behavior of vegetation in outlet channels (1, 2, 3). The principles reported would apply regardless of locality.

In 1954, Soil Conservation Service technicians in New York and Pennsylvania studied a large number of established outlets. It was evident that construction, lime and fertilizer, seedbed preparation and seeding methods needed careful attention. It was also evident that plants not previously or adequately tested should be tried. Valuable suggestions for setting up field plantings were received from Cornell University and Pennsylvania State University. Much attention was to be given to the establishment of a dense lining of vegetation in constructed channels. There was evidence from research results and experience that grass sod offered the most practical protection.

In 1955, thirty field plantings were made on selected channels on Soil Conservation District cooperator farms; thirteen were added in 1956, and ten in 1957. Reed canarygrass, tall fescue, red fescue, creeping bentgrass and Kentucky bluegrass are the permanent grass species being compared. In some plantings a comparison was made between domestic ryegrass and redtop to determine the better companion grass to use. The mixtures, used in all plantings, were composed of one permanent grass and one quick-starting grass (ryegrass or redtop) for early cover. Birdsfoot trefoil was added to several of the plantings.

Lime and fertilizer applications were based on SCS technical specifications. Lime was to be applied to bring

Figure 1. Several mixtures are being tried in this outlet on the D. Seymour farm in Tioga SCD in Pennsylvania. The dark plots are red fescue.

Figure 2. Excellent cover was obtained within two months after seeding, mulching and tying mulch in place with paper-twine net on this diversion terrace outlet.

the pH to 6.5. The minimum fertilizer recommendation on any planting was 1,000 pounds of 5-10-10 per acre. Manure was to be used when available. The majority of cooperators met the recommendations, although a few cut down on both lime and fertilizer, and several were more liberal.

Results

1. *Time of seeding.* The early spring and August seedings were best. Seedings made from mid-June through July, and September or later were not satisfactory. Mulching helped to extend the suitable seeding period, but it seems preferable to use an adapted temporary crop for any unsuitable periods.

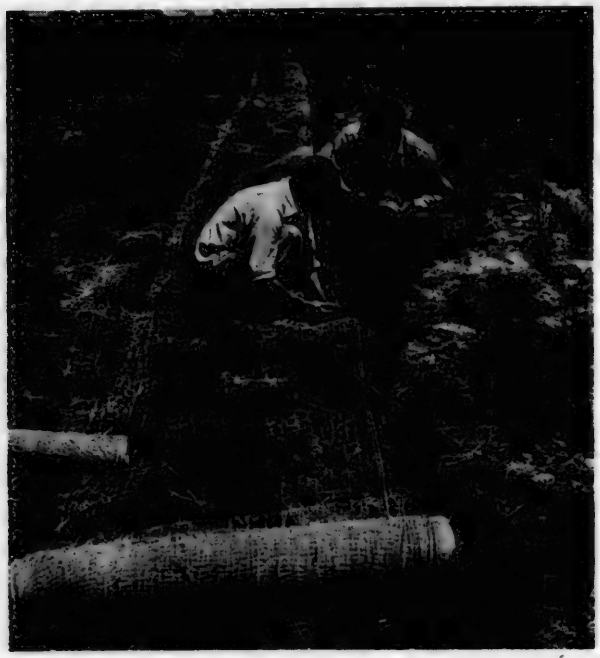

Figure 3. Mulch alone is not enough. The mulch had to be carefully held in place. Here a paper-twine net is being tied in place to hold the mulch.

2. *Fertilization.* The 1,000-pound rate of 5-10-10 seemed barely adequate. Where higher amounts were used both emergence and later development wre improved. Best results were obtained with manure applied at 15 tons or more per acre with 500 pounds or more of 10-10-10.

3. *Seedbed preparation and seeding method.* Careful seedbed preparation and seeding methods were of obvious benefit. Reed canary grass is particularly sensitive to seedbed condition and seed coverage. Cultipacking before and after broadcasting the seed was the most satisfactory means of covering seed. A firm seedbed was also very important in resisting scouring. In two 1957 plantings the channels were firmed after seeding with a wheel tractor to provide additional resistance to scouring. Emergence and growth of seedlings was good. Drill-row establishment, where used, was objectionable. Drilled in fertilizer resulted in establishment of grass in rows even though the seed was broadcast.

4. *Mulching.* Many channels, even where water from outside the channel area was excluded, needed protection during the germination and emergence period. Channels on slopes of five per cent or greater needed mulch. The only exceptions were channels less than 300 feet long or having an accumulation area of less than one fourth acre. Mulch had to be carefully tied in place. In 1957, eight plantings were protected with tied down mulch. A new open-mesh paper twine material was used in seven of these plantings. It was very satisfactory when carefully tied down and was low in cost and easy to handle.

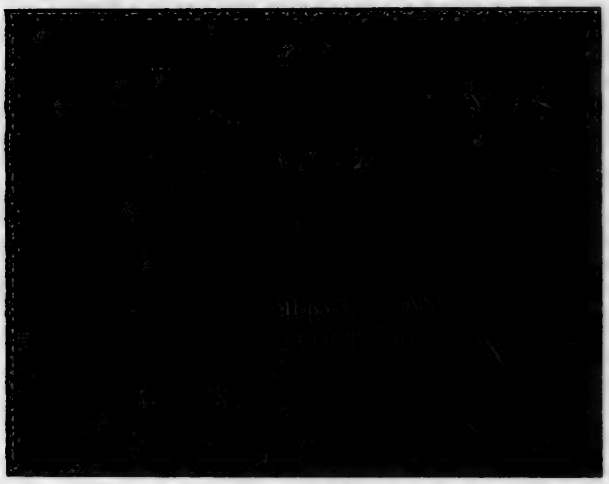

Figure 4. Reed canary grass and birdsfoot trefoil at the end of second season. This mixture, tested on the Mervin Lang farm in the Cortland (N. Y.) SCD, produced very heavy cover and established rapidly when timely, well-fertilized seedings were made.

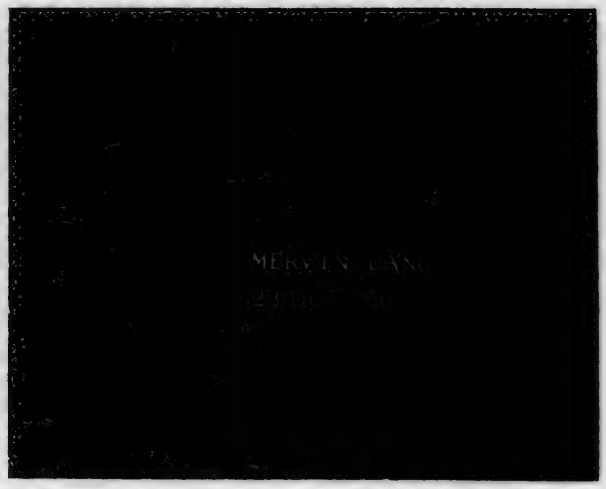

Figure 5. Tall fescue and birdsfoot trefoil at the end of second season—M. Lang farm. This mixture is outstanding in rapidity of establishment and year-round density of cover. Through 30 field test plantings, like this, much was learned about establishing adequate vegetation on difficult sites.

Mulch stuck together with asphalt was not used but should be valuable to hold mulch against movement by wind. Mulching aided emergence and helped lengthen the suitable seeding period.

Species

The outstanding permanent species were tall fescue and reed canary grass. Both emerged quickly and established well under good conditions. When conditions were less favorable tall fescue emerged more uniformly and produced better cover than reed canary grass. Two of the mixtures (tall fescue, redtop and birdsfoot trefoil) and (reed canary, redtop and birdsfoot trefoil) were superior in getting started quickly and in establishing dense cover. Birdsfoot trefoil added greatly to the total effective cover. It grew well under severe conditions and aided the grasses.

The red fescue, redtop and birdsfoot trefoil mixture developed well in the second and third years. The chief disadvantage of red fescue and Kentucky bluegrass is slowness of emergence and growth the first year. A quick-starting grass is definitely needed with these two species. Ryegrass started quickly but was aggressive and reduced the establishment of permanent grasses. Observations indicated that the ratio of permanent species to redtop should be increased. A mixture of 20 pounds of red fescue, 5 pounds of redtop and 7 pounds of birdsfoot trefoil was used. In some plantings with this mixture, redtop appeared too thick for the good of the permanent species. There is evidence (4) that redtop will dominate when it makes up 20 per cent or more of the grasses in a mixture. Studies on seedling competition in establishing forage plants (5) indicate the importance of lower seeding rates for aggressive species when used with permanent species.

Summary

The sites on which plantings were established (1955-1957) represent the most severe outlet problems encountered in southern New York and northern Pennsylvania. Observations indicate that the quality of outlet vegetation can be improved by careful attention to: (1) approved design and construction; (2) exclusion of as much of the watershed as possible during the establishment period; (3) adequate liming and heavy fertilization including manure; (4) good firm seedbed and recommended seeding practices; (5) mulching and tying mulch in place if necessary; (6) timely seeding; (7) the use of adapted mixtures, and (8) good management to maintain fertility and avoid damage by traffic and livestock.

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Wind Erodibility of Farm Fields

W. S. CHEPIL

The author indicates how width of field is interrelated with other major factors that influence erosion of soil by wind. He indicates too how the wind erodibility of any field or field strip may be determined for any soil, surface condition, and wind velocity and direction. Graphs and alignment charts are presented for convenient determination of field erodibility or of conditions required to reduce the field erodibility to any degree.

THIS is one of a series of papers based on studies to develop a convenient method of estimating relative susceptibility of farm fields to erosion by wind. Previously four major factors have been approximately evaluated (4, 5). They are soil cloddiness, quantity of crop residue or vegetative cover on the surface, surface roughness, and susceptibility of the soil crust to abrasion by bouncing soil particles.

This paper presents information particularly on the method of evaluating a fifth factor—the width of field or field strip. The original data on which this evaluation is based are contained in previous publications (3, 1, 2). Those data are a result of measurements of the rate of soil movement at different distances downwind across fields and field strips during the time they were being eroded by wind.

The purpose of developing a method to evaluate the influence of size of field is to give the soil conservationist a convenient device for determining what width of fields or field strips is necessary under any condition to reduce the rate of erosion to any degree. It is believed that evaluations such as these will give a better understanding of wind erosion and will serve as tools for determining more conclusively what conditions are necessary for its control.

This paper is a joint contribution from Soil and Water Conservation Research Division, Agricultural Research Service, U. S. Department of Agriculture and Department of Agronomy, Kansas Agricultural Experiment Station, Department of Agronomy Contribution No. 640.

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This is primarily a numerical rather than descriptive analysis of the subject. Many of those to whom the paper may be of interest may be discouraged by this type of analysis. The numerical analysis by use of charts has been chosen because it is believed it can best yield information that can be interpreted but one way only. Ramifications arising from use of the charts rest with the people who will use them.

The Influence of Width of Field

Soil movement across wind-eroding fields may be likened to an avalanche rolling down the mountain. The avalanche grows in volume as it rolls downhill. So too does soil movement across eroding fields. The rate of soil movement on the windward side of the field is zero. From this point it increases more or less proportionately with distance downwind until, if the field is large enough, a maximum rate is reached. The distance required for soil flow to reach the maximum on a given soil is the same for any erosive wind. It varies only and inversely with erodibility of a field surface. That is, the more erodible the surface, the shorter the distance in which maximum flow is reached. The relationship between wind erodibility and distance required for soil flow to reach a maximum rate is shown in Figure 1.

The maximum rate of soil flow in a given wind is remarkably uniform for all field surfaces. It is equal to about 2 tons per rod width per hour for a 40-m.p.h. wind velocity at 50 feet above an unsheltered, level terrain. The rate of soil flow beyond this point on the terrain is constant. It represents the maximum concentration of moving soil particles that a wind of this velocity can carry. The maximum rate of flow is seldom reached because fields are usually limited in size.

The increase in rate of soil flow with distance downwind across an unsheltered wind-eroding area is called *soil avalanching*. Its recognition in a way has resulted in adoption of various forms of strip cropping for wind erosion control.

Wind erodibility is expressed in this paper in terms of relative quantity of erosion and as rate of soil flow. The use of the two systems is unavoidable. It arose from erodibility measurements in a wind tunnel and in the field. In a tunnel the rate of soil flow for cultivated land drops rapidly with duration of exposure so that it can be expressed only in terms of quantity of soil removed from unit area before soil removal has ceased. In the field, due to much larger area and consequent substantial abrasion from bouncing soil grains, erosion does not

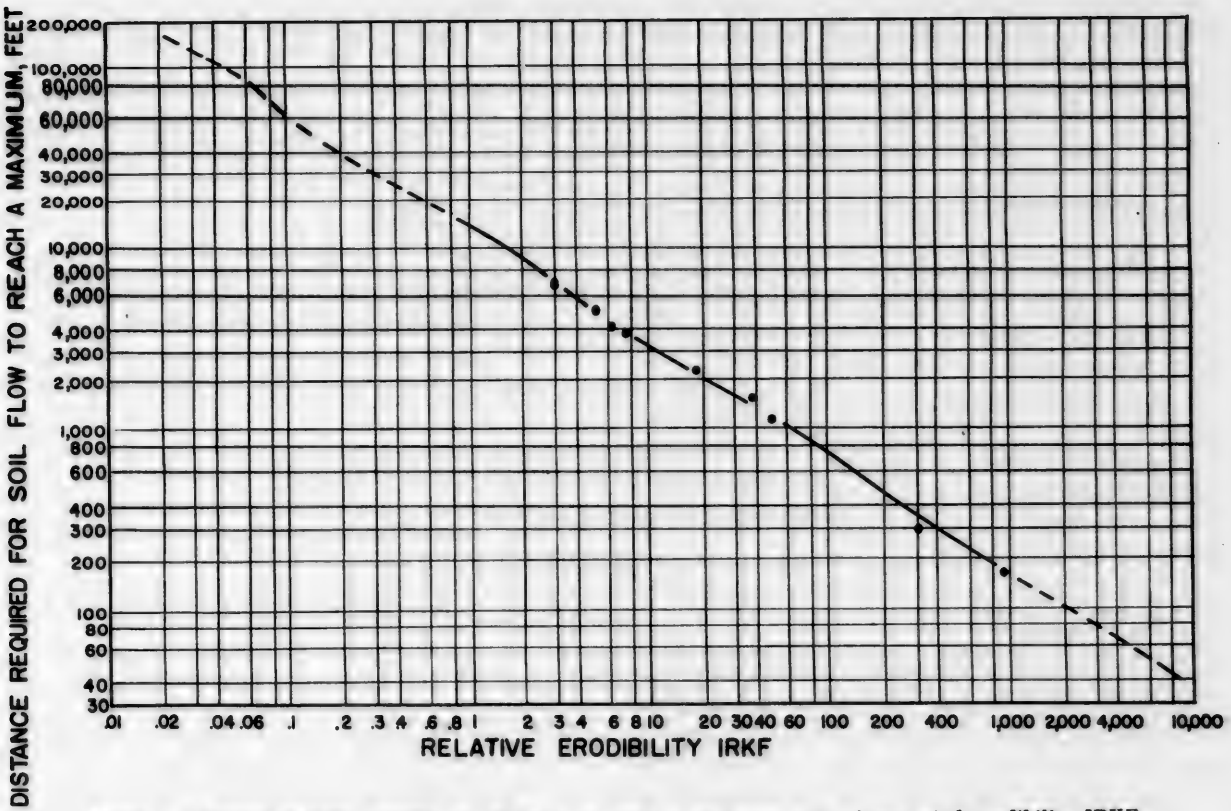

Figure 1. Relation between distance for soil flow to reach a maximum and relative wind erodibility IRKF.

cease except from very small areas so that wind erodibility can be expressed only in terms of rate of soil flow.

The wind velocity level on which this analysis is based is 40 m.p.h. at 50 feet above a smooth, level and unsheltered terrain. According to Zingg (7), this velocity at Dodge City, Kansas, occurs once in 2 years on the average for a 6-hour period during April. This wind velocity level is taken as standard in determining relative field erodibility. Little information is available on wind velocity level for various geographic locations and on its influence on wind erodibility. It is therefore not included in the present analysis.

Factors Influencing Wind Erosion

The quantity of wind erosion E may be expressed by a generalized equation

$$E = IRKFBWD \qquad \textit{(equation 1)}$$

in which, I = Soil cloddiness factor
R = Crop residue factor
K = Ridge roughness equivalent factor
F = Soil abradability factor
B = Wind barrier factor
W = Width of field factor
D = D wind direction factor.

There are other factors that influence the quantity of erosion, but the above appear to be the major ones. Erodibility as determined from factors I and F is soil erodibility; that based on additional factors R and K measures the surface erodibility; and that based on all recognized factors determines the field erodibility.

An alignment chart and table have been drawn up in a previous publication from which the influence of factors I, R, K, and F may be determined (5). Also, it was shown how procedures may be reversed to determine what conditions of I, R, K, and F are necessary to reduce the quantity of erosion to any degree.

Determining the Influence of Wind Barriers on Erodibility of Various Sizes of Fields

The portion of the field that is completely sheltered by any barrier such as stubble, crop, hedge, or tree windbreak that may be present on the windward side of a field must be subtracted from the portion that is not. Insufficient information is available on the relative influence of various types and heights of barriers on erosion of soil by wind. Therefore, an evaluation of wind barrier factor B in relation to erodibility of various sizes of field or field strip must be only approximate at the

present time. According to Woodruff and Zingg (6), distance of full protection from wind erosion can be expressed approximately by

$$d = h(17 \frac{v_o}{v}) \qquad \textit{(equation 2)}$$

in which d is distance of full protection from erosion, h is height of barrier expressed in same units of measure as distance d, v_o is the minimum wind velocity at 50-foot height required to move the most erodible soil fraction, and v is the actual velocity at 50-foot height. The minimum velocity required to initiate soil movement on a smooth, bare surface after erosion has been initiated and before wetting and subsequent surface crusting by rain is about 21.5 m.p.h. at 50 feet above a smooth and level terrain. Consequently, equation 2 for this condition, which is rather common in spring before the land is cultivated and when wind erosion is most likely to occur, may be expressed by

$$d = \frac{365\,h}{v} \qquad \textit{(equation 3)}$$

The chart of Figure 2, developed from equation 3, can be used to determine distance of full protection from wind erosion. Corresponding values of height of barrier and distance of full protection are aligned along a vertical axis. Only the influence of barriers up to 4 feet in height, such as stubble or crop, are given. The distance of full protection from barriers taller than 4 feet can be computed readily from equation 3.

Distance d is distance along prevailing direction of wind. It is the distance that is fully protected under a wind velocity of 40 m.p.h. at 50-foot height. The total distance across the field along prevailing direction of wind minus distance d indicates distance d_t that is unprotected from the wind. If the barrier such as stubble is knocked down by tillage, the completely sheltered zone d would be virtually eliminated and erosion-susceptible fields or field strips should be that much narrower to have the same field erodibility. On the other hand, if the wind barrier is much taller than the stubble, the completely sheltered zone would be considerably greater, as shown by Figure 2 and equation 3, and the erosion-susceptible fields or field strips could be widened considerably and still be able to keep wind erodibility down to a tolerable degree. The field erodibility is dependent directly on distance d_t, that is, on distance (measured along prevailing direction of wind) that is not protected from the wind.

Determining the Influence of Width of Field and Direction of Prevailing Wind

Evaluation of factors W and D may be made from the chart shown in Figure 3. This chart was developed from Figure 1 and from data contained in two previous publications (2, 5). The procedure simply is to convert the relative surface erodibility based on factors I, R, K, and F to relative field erodibility based on additional factors B, W, and D by use of Figure 3.

To convert the relative surface erodibility IRKF to field erodibility IRKFBWD, proceed as follows:

1. Find IRFK value on the left side of chart (Figure 4).
2. Move from this point to the right along or between and parallel with thick erodibility lines until the unprotected distance d_t of field along prevailing direction of wind shown on top of the chart is reached.
3. Read IRKFBWD value for this point by moving to the extreme right along or between and parallel with thin, co-ordinate lines.

The procedure with Figure 3 can be reversed to determine the unprotected distance across the field along prevailing direction of wind required to reduce the field erodibility to any degree.

It will be observed that the IRKFBWD values in Figure 3 remain constant for any width of field down to some critical width, depending on the relative erodibility level of the field. As the field is narrowed still more, the rate of soil flow and hence the relative erodibility IRKFBWD drops—the drop being slow at first but becoming progressively more rapid and finally attaining a constant rate.

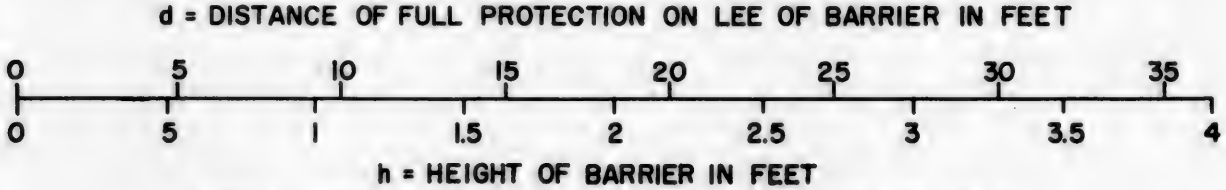

Figure 2. Alignment chart for determining distance of full protection from wind erosion afforded by barriers of various heights exposed to a standard wind velocity level.

These relationships hold true for all conditions of field surface but at different levels depending on the relative surface erodibility IRKF.

Field erodibility is governed by the maximum unprotected distance across the field along prevailing direction of wind. If only the dimensions of the field or field strips

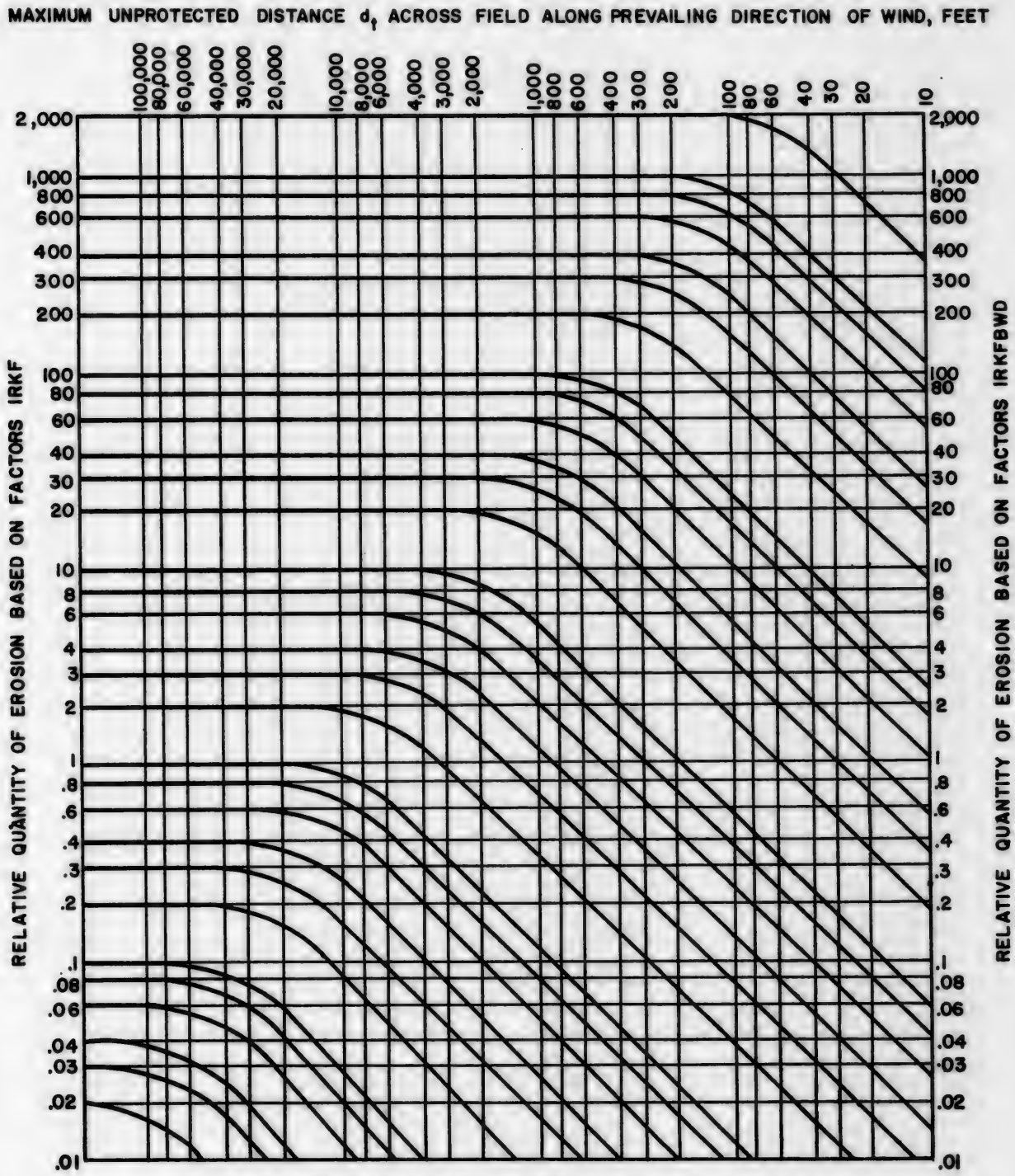

Figure 3. Chart showing the relationship between relative quantity of wind erosion and width of field along prevailing direction of wind.

are known, this distance can be determined conveniently by use of Figure 4 as follows:

A straightedge is passed through the width of field or field strip on line EF and through value of angle of deviation of prevailing wind direction from perpendicular to field or field strip on line CD. The maximum distance across the field or field strip along prevailing direction of wind lies at a point where the straightedge crosses line AB. This distance minus the distance d along prevailing direction of wind protected by any barrier that might exist on the windward side of field or field strip is equal to the maximum unprotected distance d_t across the field or field strip along prevailing direction of wind.

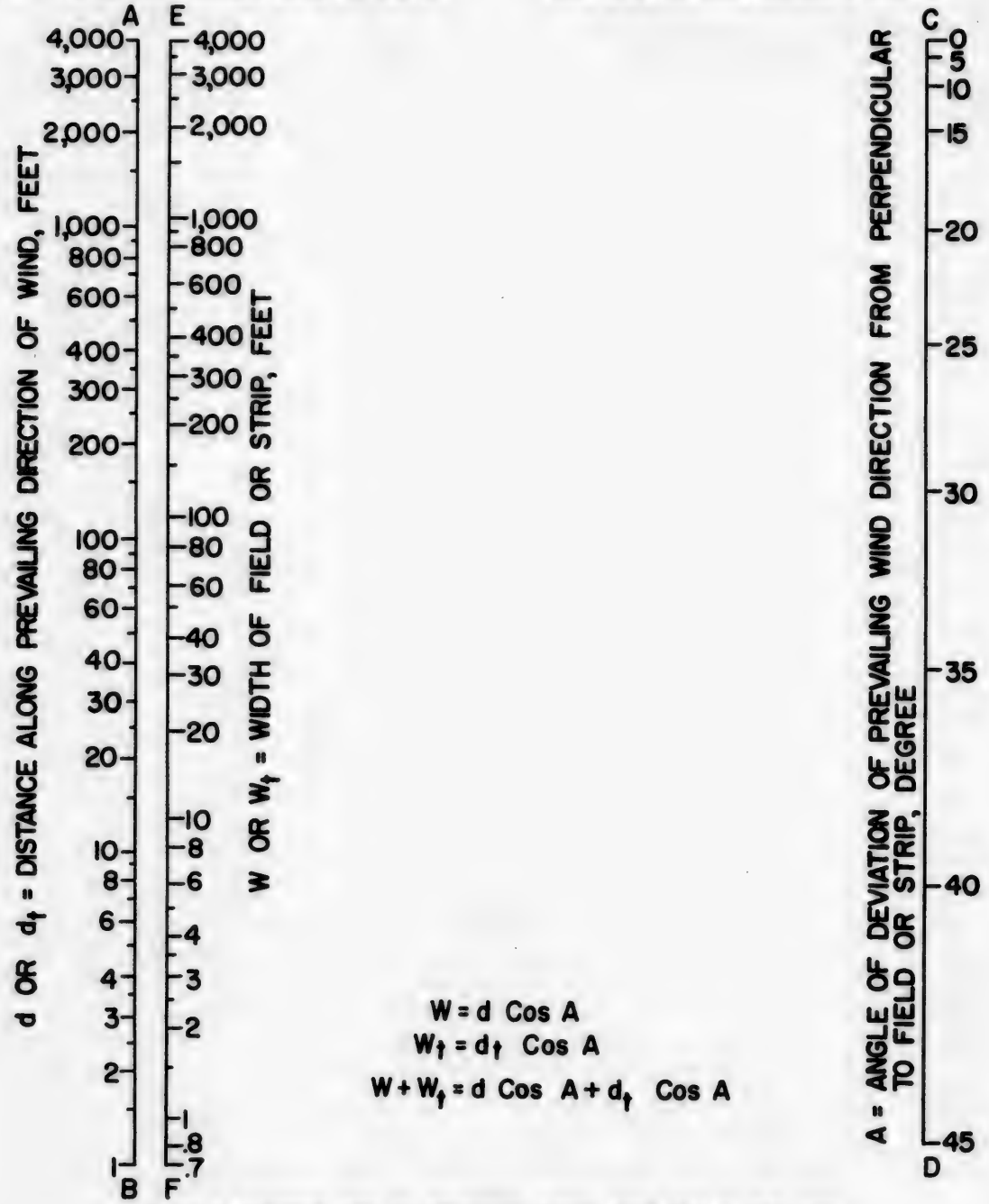

Figure 4. Alignment chart for determining distance across field or strip along prevailing direction of wind from the width of field and the direction of wind.

Figure 4 can also be used to determine the required width of field or field strip from distances (d and d_t) along prevailing direction of wind and from the angle of deviation of prevailing wind from perpendicular to field or strip. Simply pass a straightedge through distance d, d_t, or $d + d_t$ on line AB and angle of deviation A on line CD and read the desired width of field W, W_t, or $W + W_t$ on line EF at a point where the straightedge crosses it.

Example of Use to Determine Field Erodibility or to Determine Width of Field Required to Reduce Field Erodibility to Any Degree

Suppose that the field is 1,000 feet wide along east-west direction and 2,640 feet along the north-south direction; stubble 1 foot high surrounds the field; the prevailing or average wind direction is oriented along the west-northwest and east-southeast axis; and as determined by procedure described by Chepil and Woodruff (5), surface erodibility IRKF is 2.

First, we shall determine the field erodibility. The angle of deviation of prevailing wind direction from perpendicular to broad side of the field or the west-northwest and east-southeast axis is 22.5 degrees. As indicated before, the field width $W_t + W$ is 1,000 feet. Therefore distance $d_t + d$ across the field along prevailing direction of wind, according to Figure 4, is about 1,100 feet. Distance d, that fully protected by the 1-foot stubble, according to Figure 2, is approximately 8 feet. There, the unprotected distance d_t is $1{,}100 - 8 = 1{,}092$ feet. Moving from IRKF value of 2 on the left hand side of Figure 3 along the thick erodibility line till the maximum unprotected distance d_t of 1,092 feet shown on top of the chart is reached, then moving horizontally to the right, shows the relative field erodibility IRKFBWD of about 0.42.

Next, we shall determine what width of field is required under the prevailing surface conditions to reduce the field erodibility to some desired degree. Suppose it is desired to reduce the field erodibility to a negligible value of 0.25. According to Figure 3, the maximum unprotected distance d_t across the field along prevailing direction of wind would have to be about 750 feet to reduce erodibility IRKF of 2 to IRKFBWD of 0.25. Distance d protected by the 1-foot stubble is 8 feet and the total distance $d_t + d = 758$ feet. For prevailing wind velocity deviating 22.5 degrees from perpendicular to the broad side of the field, the required width of field for the existing surface conditions, according to Figure 4, is approximately 680 feet. Of course, the field erodibility may be reduced more conveniently by other means than reducing the width of field. Such other means may be increasing cloddiness I, residue cover R, surface roughness K, or height of barriers B. The tables and alignment charts of this and previous papers will indicate by how much the various factors need to be modified to reduce the field erodibility to any degree.

Conclusion

Alignment charts and formulas evaluating various wind erosion factors listed in equation 1 show average effects of variable conditions existing in the field. The residue factor so far has been evaluated only for quantity above the surface of the ground regardless of kind. The influence of orientation of residue in relation to the ground surface and direction of wind is hardly explored. Little is known of the influence of various types of barriers on the quantity of soil erosion by wind. Little information, too, is available on the influence of general velocity level and average direction of wind at various geographic locations. Effects of soil moisture conditions on wind erodibility have been hardly explored. Further research on these and related problems should result in refinements of the present methods of evaluation. The series of papers of which this one is a part indicates primarily the general framework upon which research information on conditions required to control wind erosion can be built.

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Protective Forestry in Switzerland

PAUL J. ZWERMAN AND FELIX RICHARD

IN SWITZERLAND a key role is played by forestry in the conservation of soil and water resources, in protecting lives, in protecting roadways and in maintaining the economic stability of the country (14). Within the last hundred years, the Swiss have realized the importance of improved forestry management and research. It took a national catastrophe followed by strict federal forestry laws to unite and control those interested in the land.

During the period of the Roman Empire, the early settlers in Switzerland lived within the shadow of magnificent forests. The original forest of "Urwald," as it was called by the German speaking Swiss, covered the entire country and represented an equilibrium between climate, soil, and vegetation. This equilibrium, unless disturbed, allowed very little economic return to the society, but there was a stabilization or natural balance of soil and water relations.

Natural forests were not to remain intact. Trade and industry were developing. The forest had to supply wood for construction not only in Switzerland, but all over Europe. Industry demanded fuel. During the 17th century, many natural forests were clear cut. Within the watershed of the Rhine River much of this timber was floated to markets in other European countries (8). Industry also moved into the forest to exploit it more completely. The glass industry from Germany moved into Switzerland where a good supply of wood was available for the production of necessary charcoal (6).

Even as early as 1800, there were farsighted individuals who voiced warnings against the destruction of the forests with its possible consequences (7, 15, 16). The farmers with no economic incentives to restore these forests, gave little heed to the warnings. These early malpractices were later to have their influence within the Swiss Republic itself.

The first recorded and serious wide-spread floods in Switzerland were in the early 1830's. The federal government appointed a technical commission in 1850 to study the costs of flood control on numerous small tributaries of the major rivers. This headwaters flood control commission had made extensive studies by 1864 and gave detailed reports on costs (3). Flood control methods used in France had been studied. While the commission's report was under consideration during 1868, the most disastrous flood of Swiss history took place. There were 50 known dead. Damages amounted to 14-15 million dollars over an area of about 100 million acres.

A federal commission was appointed to investigate the causes of the disaster (1). This commission had but to point to numerous previous reports which indicated the very sad condition of the so-called forest. In certain watersheds the forest cover had fallen as low as 6 to 10 per cent of the total area. The first Swiss Forestry Law was passed in 1872 (4) and forestry practice became a part of the Constitution (2).

The Federal Forestry Law of 1872 divided the wooded area into protective and non-protective forests. The Swiss Lowland and the Jura were not considered to be problem areas. Therefore, the protective feature of the law was considered to apply to the Alps and the steeper lands adjacent to these mountains; where lack of forests was known to greatly increase avalanches, land slides, erosion, and height of flood stages. In the protective zone, the forest area could not be diminished.

This law preceded most of the experimental work on forestry, although the College of Forestry had been founded in 1855 as a part of the new Federal Institute of Technology. Early forestry teaching was based on practice and experience rather than experiments. In 1888 the Swiss Forest Research Institute was founded. Practicing foresters trained in the College were demanding more information with respect to the influence of forests on runoff and flood flows.

In 1900 the Swiss Forest Research Institute started

Figure 1. "Felling." Careful attention to details results in greater utilization of wood supply and less damage to growing stock.

Joint contribution from the Swiss Forest Research Institute, Birmensdorf, Zurich, Switzerland, and the Department of Agronomy, Cornell University, Ithaca, New York, U. S. A. Agronomy paper No. 458.

Paul J. Zwerman is Associate Professor of Soil Conservation, Cornell University. Felix Richard is Soil Scientist at the Swiss Forest Research Institute, Birmensdorf, Zurich, Switzerland.

Figure 2. Bringing out a log. Here is a "conservation" skill. Careful use of horses ensures less damage to growing stock and less disturbance of soil and duff. Swiss forestry is remarkably productive.

Figure 3. Motorized equipment is important in getting logs to saw mills. In Swiss forestry operations modern equipment is combined adroitly with old and tested use of horses. The forest pictured here yields 1,800 board feet per acre.

its now world-famous research on the influence of forests on runoff. Publication of these investigations (5) in 1919 greatly influenced the practice of forestry. Relationships of forests, soils, water and runoff were recognized. The Federal Forestry Law was amended to give greater freedom to the foresters in distinguishing between protective and non-protective forests.

Forestry Research in Practice

The Swiss have within their borders the headwaters of all the major rivers of Europe. Here the Rhine, the Rhone and the Inn have their sources. These rivers start on mountain tops, on levels too high for forest and vegetation. Here precipitation is very heavy. The soils are primitive and develop slowly out of parent rock. In these areas of snow, glaciers, and heavy precipitation, there is constant danger of avalanches, landslides and torrents. How can the Swiss people not only protect themselves from but best utilize economically these natural forces of tremendous potential energy?

Protection of lives and property in the valley areas was a primary goal. This was recognized by the Federal

Figure 4. Mechanical site preparation and nurse tree plantings are necessary to convert certain areas into forest. Bundles of willow branches are covered with soil on the contour.

Figure 5. The willows have sprouted and serve as nurse trees on this steep slope. This is the same slope shown in Fig. 4, but four years later. Gullying is now under partial control.

Government which founded the Institute for the study of avalanches in 1935 (12). This Institute engages in fundamental research work and trains people in the science of constructing barriers to hold avalanches. These barriers are necessary and effective at higher elevations above the timber line. The forest growth itself is more effective at the lower elevations. So in a sense the science of studying avalanches and mechanical control can be looked upon as a first line of defense, while a zone of forests or a dense line of forests in the Alpine zone can be regarded as a second line of defense. Since almost 20 per cent (11) of the Swiss population live in these mountainous areas and graze their cattle in the mountain meadows, the protection from avalanches and soil slippage is important.

Alpine zone forests are effective in conserving water. They materially cut down the peak flow from floods (5) and regulate the flow of water to important hydroelectric stations producing a third of all the power consumed in Switzerland. During the next 25 years the Swiss government anticipates spending 12 billion Swiss francs for development of hydroelectric power. Protective watersheds are essential to the steady flow of water. Irregularities in flow would materially disrupt the supply of power that is now very closely balanced with consumption.

Figure 6. To protect lives and property, avalanche structures are necessary on the steeper slopes. Here are some lightweight aluminum barriers.

Figure 7. Observations being made on prestressed concrete avalanche-control structures. Wood and iron barriers are also used.

The Federal government has recognized the importance of forestry in the mountainous areas. Direct grants have been made for building access roads. Since 1876 the Federal government has granted 53 million francs (11) to the various Cantons for avalanche structures, stream stabilization, drainage and afforestation.

At the critical elevations above 1400 meters (4,650 feet), the management of the protective forests becomes further complicated by difficulties of accessibility and the limited number of species of trees that will grow. Temperatures are very low in the winter and the growing season is short. The Federal Forest Experiment Station has set up a program of breeding and selecting adapted trees. Efficient means of removing logs from these difficult areas are being developed.

At the lower elevations the forest has a relation primarily to dairy farming. The forest protects the lowlands by reducing flood peaks. The forests also offer protection against the wind. Because of grass and the relatively small areas of the fields there is little soil erosion.

Certain land patterns have led to conflicts between grazing and forestry. Cattle have destroyed young trees, compacted soil and destroyed forest litter. Recommendations have been made such as better management of pastures and fencing off the forest areas (13).

As industrial opportunities become more attractive to the small farmer, there is a population movement from the mountainous areas toward the cities (11). Land has been purchased by the Communities and the Canton governments for afforestation (14). Small private holdings have been consolidated to permit better management of the forests (9).

The future development in Swiss forestry will be toward increasing the protective function of the forest lands and at the same time bringing the highest economic return to the community and to the individual.

Figure 8. Steep eroded slope in Central Switzerland before reforestation. There are comparable bare slopes in many of the mountains of America on which Swiss methods of control can be tested.

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Cover-Crop Mulching in Orchards

CHARLES B. AHLSON

THE USE OF ORGANIC MATTER and the right method of tillage are important in orchard management. Sources of organic matter may include seeded or volunteer cover crops, plant residues, orchard prunings, straw, old hay or sawdust shavings or chips, and manures. Annual cover crops are a large source of soil organic matter.

Good orchard management requires early seeding of cover crops—preferably before October 15 in California. A heavy volunteer or seeded cover crop is helpful. Cereals and legumes are used, including barley, oats, rye, vetch, horse beans, Bell beans, field peas and bitter clover. Mustard and mallow are also good. Fertilizer applications may be needed.

Figure 1. Excellent mulch to check runoff from late spring rains was laid down in this demonstration of use of rotary mower in the Redwood SCD near Santa Cruz, California.

A *properly* managed annual cover crop returns organic matter and nutrients to the soil and does not compete with the trees for moisture and plant food. Research on tillage has shown that residue left on the surface adds organic matter to the soil more rapidly than when turned under or mixed with the soil. With less tillage, desirable soil structure is maintained, i.e., the soil will be crumbly and not pack.

Organic residues on the surface break the impact of the rain drops or sprinkler drops. Water intake is increased and erosion is reduced.

Charles B. Ahlson, at the time this work was done, was management agronomist, SCS, with headquarters in Watsonville, California. He is now retired. In this "how-to-do-it" article, he describes certain mulching procedures which have received enthusiastic acceptance among orchardists in seven Soil Conservation Districts in the Watsonville area some 100 miles south of San Francisco. In the studies, SCS technicians, district directors, and Extension specialists of the University of California have cooperated.

Most orchardists use a disk in managing cover crops. The disk compacts soils and its use should be limited. In drylands, some orchardists have found two disking operations annually are sufficient: one as late as possible in the spring and one just before harvest. On irrigated orchards three cultivations usually suffice. In using a disk, care should be taken to keep most of the residue on the surface.

Mulch residues may interfere with the harvest of prunes, walnuts and almonds. Cover-crop management or harvesting operations may have to be changed or adjusted.

In order to find better methods of reducing tillage operations and leaving cover-crop residues on the surface, power rotary-mowers were tested. These machines eliminated the cost of collecting, hauling and burning of prunings. They also reduced limbs up to three inches in diameter to shreds, thus adding tons of organic matter to the soil. Farmers who have used rotary-mowers from three to eight years state that insects have not increased.

Power mowers can be set to cut the cover crop at the

Figure 2. In this demonstration held in the Evergreen SCD, San Jose, California, a rotary mower shredded prunings. Past practice had been to haul away and burn such material.

Figure 3. The shredded cover crop and prunings form good mulch and aid in rebuilding the organic content of the soils in the orchard. The method seems to be more economical, too.

soil surface, thus reducing moisture competition with the trees. The mulched material serves to add organic matter and plant nutrients to the soil. The mulch also improves penetration of water, reduces surface evaporation and reduces soil erosion on sloping land. The fire hazard is reduced because the mulched materials decompose rapidly and are mixed with some soil in subsequent operations. Power-mowed mulch does not impede the operation of spray equipment and the moving of sprinklers. Decomposition in plant roots, such as mustard and mallow, opens additional subsurface channels to water. Early disking has a tendency to seal off such channels; power mowing does not disturb them.

Engineers tell us a disk is almost as efficient as a sheepsfoot roller in compacting soil. Observant farmers notice that some soils take water readily before disking down a cover crop, but they also see irrigation water not readily entering some soils after one or several diskings. The combination of pulverized and packed soil and retarded water intake usually results in reduced vigor and production of trees. The question is: How can orchardists manage soils to reduce compaction and erosion and hold down operating costs?

Although some of the problems involving cover crop mulching in orchards have been clarified by farmers' experiences, more trials are desirable. The addition of more organic matter to orchards and the reduction of tillage operations which lead to soil compaction must be tested on a variety of soils. More research is needed on both irrigated and dryland conditions. On some soil types it may take several years to develop enough mulch on the surface to prevent the soil from baking or getting hard. To prevent some soils from baking, it may be necessary to disk lightly and superficially. Improvements can be made in the effects of disks by using depth-control rollers or hydraulic controls. Disks thus equipped can be controlled to shave off the regrowth and leave it on top of or in the top part of the soil. Depth-control rollers or gauges are now available commercially to fit on the spindle or axle of a disk.

In further trials the power mower is being used to reduce the cover crop and prunings, with a subsurface blade or sweep used to check regrowth. Some growers will later in the season use the power mower a second time, followed by a light, shallow disking with a cultipacker in tandem to smooth the surface for harvesting.

Conclusions

California orchardists, who have cut down on cultivating, are convinced that excessive tillage is detrimental and an unwarranted expense. Resourceful orchardists are developing mulching systems to improve soil and water management. Protection of soil surface, improvement of soil structure and fertility, and water intake are some of the fundamental practices now being considered by the more progressive orchardists.

Field Notes

DRAINAGE AND FLORIDA'S CITRUS LAND

Florida's valuable citrus belt, threatened by rapid urban development, will lose 50 per cent of its orange acreage in the next ten years if urban growth is maintained at the present rate in Orange County alone. With the proximity to Cape Canaveral and the recently built plants of Martin and Bell Aircraft near Orlando, plus strong rumors of other companies moving to this area, it seems likely the estimates may be correct.

There is also a terrific demand for citrus products, spurred by modern freezing methods, which shows no sign of abatement. Citrus growers need more, not less, land.

Much of Florida's land is very flat, with a high water table. From the air, the citrus belt is studded with small lakes. Citrus trees will not produce good crops unless they have a depth of at least four feet of well-drained land in which to grow healthy, large root systems. Where the water table is above this level, trees remain small. Wet plots will not support citrus trees at all.

Assuming the soil conditions to be suitable for citrus growth, wet areas may be drained to the four-foot depth, in which case they will provide good groves furnishing high yields of fruit.

Figure 1. The drainage began with deep trenches dug by machine. Filter material, crushed gravel, covered bottom and around pipes. Fiber pipes with two rows of 5/16 inch diameter holes spaced 3 inches apart at 120° were laid in 8-foot lengths joined with snap couplings.

Figure 2. A 900-gallon per hour flow was running shortly after installation of pipe lines. The water table was lowered 10 inches the first hour. Harold Maguire, left, grove owner, discusses project with Donald Vandergrift, SCS technician, center, and J. W. Hammett, SCS state conservationist.

A drainage system consists of an underground pipeline to collect water. Pipes are laid with a slight slope to lead the water downhill to collection ditches. The ditches lead water off to a disposal area, often a small lake, at lower elevation. In other areas, water may be collected and pumped over a dike.

A twenty-acre plot was drained with bituminized fibre pipe recently in a demonstration at Maguire Groves near Orlando. The plot had a water table so high it drowned a previous citrus planting. For drainage, the manufactured pipe used is made with two rows of 5/16-inch diameter holes spaced at 120° and three inches apart. The pipe is placed in a bed of filter material which has several functions: It prevents entry of soil into the pipe, which could clog the system; it prevents soil from packing tightly around the pipe, which would reduce efficiency of the system; and it, in effect, produces an unrestricted drainage pipe because water collection filters through the entire periphery of the filter material. Filter beds form a highly permeable envelope around the pipe and materially increase the rate of filtration.

Filter material may be cinders, crushed gravel, or sawdust. In the Maguire Grove demonstration, crushed gravel was used to surround the pipe. Its effectiveness is shown by the fact that within a very short period of time, a flow of from 500 to 900 gallons per hour was flowing out of each line. In only twenty-four hours, the water table was lowered ten inches.

Once Harold Maguire had determined to try to reclaim this plot, he called in technician Donald Vandergrift of Soil Conservation Service, U. S. Department of Agriculture. Mr. Vandergrift analyzed the soil to determine its suitability for citrus planting if drained. When it was determined the Class II land was otherwise suitable for orange trees, he set about planning a drainage system.

Vandergrift specified that drainage pipe should be spaced at 120-foot intervals and that the pipe depth should be four feet. This depth would assure ample room for good root development without double-bedding techniques, which are troublesome in cultivation.

Before drainage, Maguire's plot was valued at $300 per acre. Once drained with a citrus possibility, its value jumped to $750 per acre. When orange trees are bearing, the going price of bearing citrus land is upwards of $5,000 per acre. For a total drainage investment of approximately $2,560, Maguire will realize a bargain. In eight years his grove should be worth about $100,000!

The whole Maguire project was viewed by hundreds of citrus growers and other interested persons. Soil Conservation Service supplied all the engineering and technical advice at no cost to Maguire. Orange Soil Conservation District co-operated and lent valuable assistance. *(For further information write Bob Wallack, Noyes and Company, Industrial Bank Building, Providence 3, Rhode Island.)*

FORAGE TESTING IS CONSERVATION

Michigan's Mason county farmers are among the few in the nation who can get their forage tested locally for protein and moisture content.

If a Mason county farmer wonders whether a field of hay is at its best stage for cutting, he can take a sample, run in to the county extension agent's office and have it tested.

This forage testing laboratory is the first one in Michigan and one of the few in the county, according to Harold Larsen, Mason county extension director. Larsen makes the test in the well-equipped lab, now in its second year of operation.

A number of local groups backed the move to set up the lab. The county board of supervisors, Farm Bureau, the local bank and the soil conservation district all supported the lab proposal. Larsen worked with the Michigan State University dairy department in getting equipment and setting up the testing procedure.

Larsen says the most immediate use of the Forage protein and moisture test is help in balancing rations. Fitting the grain ration to the protein content of the forage can mean dollars saved in feed bills.

Dairy cost studies at M. S. U. have shown that the cost of producing 100 pounds of milk on the average Michigan dairy farm can be cut 25 per cent. Improving forage and then feeding concentrates based on the forage quality would cut this cost.

"Right now, I use the lab as an educational tool, too," says Larsen. "An analysis of forage can show a farmer what the protein content is at a particular stage of maturity. Then the farmer can become a better judge of hay quality while it is still in the field."

Getting a representative sample is a problem in forage analysis. If the hay is chopped, coarse particles in the mow will be blown farther from the blower than the fine particles. Baled hay presents a similar problem because one bale won't represent a whole field.

A forage analysis is more expensive than a soil test. Equipment is more costly and time to make the test is longer. Some authorities say that the forage test is about 10 times more difficult to do than the soil test. Because the forage testing program is new and to some extent, experimental, no charge is now being made for a test.

Larsen and others who have helped set up the forage lab point out that a protein analysis of hay is only one of the things farmers need to know about hay quality. In a study at M.S.U. scientists found that samples of hay judged excellent on the basis of a chemical analysis were not palatable or productive when fed to dairy cows.

SELECT SENATE COMMITTTEE ON WATER RESOURCES

The new U. S. Select Senate Committee on Water Resources, charged with developing information about the quantity and quality of water that will be needed by "population, agriculture, and industry" between now and 1980 and with making recommendations that may guide future water policies has held initial organization meetings.

Chairman of the Select Committee is Senator Robert S. Kerr, Oklahoma. Senator Thomas H. Kuchel, California, is the vice-chairman.

Other committee members include Senators Clinton P. Anderson and Dennis Chavez, New Mexico; Warren G. Magnuson and Henry M. Jackson, Washington; Francis Case, South Dakota; Clair Engle, California; Andrew P. Schoeppel, Kansas; Allen J. Ellender, Louisiana, Phillip A. Hart, Michigan; Milton R. Young, North Dakota; Thomas E. Martin, Iowa; Gale W. McGee, Wyoming; Frank E. Moss, Utah; Hugh Scott, Pennsylvania; and James E. Murray, Montana.

Senator Case is a member of SCSA and the South Dakota Chapter.

Theodore M. Schad, formerly associated with the Bureau of Reclamation, has been named executive director of the committee. Edward A. Ackerman, Carnegie Institution, has been hired as a consultant. The appointments of W. G. Hoyt, former Geological Survey employee, and Abel Wolman, Johns Hopkins University, as consultants are expected shortly.

The committee probably will have a revolving advisory group of experts on various phases of water resources use. The initial group is expected to assist in outlining the study objectives and procedure.

Conservationists are aware that the committee, among other things, is charged with making "suitable provision for related recreational and fish and wildlife values" in its report. It is expected that all interests will be watching to see that no single philosophy of water resources management is permitted undue recognition.

WATER RESOURCES ASSOCIATION OF THE DELAWARE RIVER BASIN ORGANIZED

The Water Resources Association of the Delaware River Basin was inaugurated at a meeting in Washington Crossing on May 22, 1959. Representatives of about 150 organizations were present. A board of 40 directors will be largely responsible to guide the new association.

The purposes of this new Association are:

1. To bring together representatives of the many and varied groups concerned with the preservation and use of the resources of the Delaware River Basin for exchange of ideas, to discover areas of common interest and agreement, as well as to discuss problems peculiar to the disparate groups and to attempt to find solutions mutually acceptable, and to explore areas of interest in which groups can complement each other rather than compete.

2. To organize a program of citizen information and education through (a) preparation and distribution of suitable publications; and (b) arranging meetings, exhibits, etc., and by taking any other appropriate steps to achieve citizen participation and understanding.

At the May organization meeting, the group also heard Russell Morgan, Chief of the Valley Report Groups of the Corps of Engineers, describe the status of their study. Dr. Roscoe C. Martin, Director of the Delaware Valley Project which is studying the governmental organization needed for planning and developing water resources, reported on their tentative conclusions. These point to the need for establishment of a new administrative agency to manage the water program for the Basin.

FAO WATERSHED MANAGEMENT SEMINAR AND TOUR IN U. S.

Some 32 representatives from 19 countries began a seminar and tour of many facilities in the United States on Aug. 10, under the sponsorship of the Food and Agricultural Organization of the United Nations. Cooperating in this project are the Forest Service, SCS, Bureau of Land Management, Bureau of Indian Affairs, Bureau of Reclamation, Tennessee Valley Authority, Michigan State University and the University of Nebraska.

The project continues through Oct. 5 and got underway with a seminar Aug. 10 at the USDA in Washington.

Many members of the Soil Conservation Society of America are involved as field coordinators en route in Delaware, Pennsylvania, West Virginia, Ohio, Michigan, Colorado, Wyoming, Utah, California, Arizona, Texas, Oklahoma, Mississippi, Georgia and North Carolina.

Complete details of agenda of tour, list of participants, and field coordinators can be obtained from FAO, 1325 C Street, S.W., Washington 25, D. C.

AGRO-FORESTRY MEETING

The second Agro-Forestry meeting for people interested in forest tree and forest soil management in the Pacific Northwest has been scheduled for Pringle Falls, Oregon, Sept. 29-30.

A meeting last year at the Pack Forest in Washington attracted agronomists, soil scientists, and foresters. There was much exchange of ideas and research findings on management of forest soils, trees, and fertilization of forest soils.

Pringle Falls Experimental Forest is in a ponderosa pine area with wind-blown pumice soils. Data on the economics of Douglas fir tree fertilization and other topics also will be discussed.

Reservations should be sent to F. Todd Tremblay, National Plant Food Institute, 2350 27th Avenue West, Seattle 99, Washington.

FELLOWSHIPS AVAILABLE

The National Wildlife Federation continues to offer a number of scholarships and fellowships to qualified individuals working in conservation or conservation education. For further information and application forms write to National Wildlife Federation, 232 Carroll Street, N.W., Washington 12, D. C. The 1960 applications close Nov. 1, 1959.

SEVENTH MEETING OF IUCN

The Seventh General Assembly and Technical Sessions of the International Union for Conservation of Nature and Natural Resources will be held at Warsaw, Poland, June 14-24, 1960, with field trips both during the Assembly and immediately following it, June 25-29, some of the trips scheduled into the magnificent mountain country and national parks of southern Poland.

The Polish Government promises excellent arrangements, and the program will include an introductory session on "The Impact of Man and Modern Technology on Nature and Natural Resources".

World attention will be focused on pesticide problems in technical sessions under the title "Ecological Effects of the Biological and Chemical Control of Undesirable Plants and Animals", and there will be sessions under the theme "Management of Wild Grazing Animals in Temperate Zones and Its Relation to Land Use."

Those wishing to receive detailed announcements of the Warsaw meeting may address: Secretary-General, IUCN, 31 rue Vautier, Brussels, Belgium. Correspondence may also be directed to either of the two U. S. members of the Executive Board of the Union, who are Harold J. Coolidge, National Research Council, Washington, D. C., and Edward H. Graham, Soil Conservation Service, Washington, D. C., the latter also Chairman of the Union's International Commission on Ecology and SCSA's representative to IUCN.

COMING EVENTS

Nature Conservancy 1959 annual meeting will be held August 31 and September 1 at Pennsylvania State University, State College, Penna., with the Ecological Society of America and the Conservancy cosponsoring a series of field trips September 3 and 4. A symposium on education, research, public use, and management relative to natural areas will be a feature of the meeting. For more information write: Nature Conservancy, 2014 Bunker Hill Road, N.E., Washington 18, D. C.

National FFA Convention, Kansas City, Mo., October 12-15.

National Reclamation Association Convention, Denver, Colo., October 28-30.

National Grange, 93rd annual convention, Long Beach, Calif., November 9-17.

The Society of American Foresters will meet in San Francisco, Calif., November 15-18 at the Sheraton-Palace Hotel. The theme of the SAF's 59th meeting is "Forestry and People".

Northeastern Weed Control Conference is scheduled for January 7-8, 1960, at the Hotel New Yorker, New York City. For further information write: M. G. Wiltse, 916 Shoreham Bldg., Washington 5, D. C.

American Society of Range Management will hold its 13th annual meeting, Feb. 2-5, 1960, at the Multnomah Hotel in Portland, Oregon. For further information write John G. Clouston, Executive Secretary, ASRM, P. O. Box 5041, Portland 13, Oregon.

National Farm-City Week, November 20-26, will stress "the common interests of farm and city people in their watersheds." The USDA Office of Information, Washington 25, D. C., is preparing a special kit of materials and plans to release a 13½ minute black and white film (tentatively titled "Water for Farm and City") for television use.

The coordinating agency for Farm-City Week is Kiwanis International, 101 East Erie St., Chicago 11, Ill.

SCSA HEADQUARTERS BUILDING

Over the last few years it has become increasingly apparent that something had to be done to improve the housing facilities for the employees and equipment of the Society. After more than a year of careful consideration of this matter the Council in session at Rapid City, South Dakota, Sunday, August 23, 1959, voted unanimously to proceed with the purchase of a plot of land in Des Moines, Iowa, and the construction of a building for meeting this need. The Development Fund Board of the Society hopes to have the help of every member of the Society in raising the necessary funds and will send letters of information to the chapter chairmen at an early date.

REGULATING FLOOD-PLAIN DEVELOPMENT. *By* FRANCIS C. MURPHY. *The University of Chicago, Department of Geography, Rosenwald Hall 24, Chicago 37, Ill. Research Paper No. 56, 204 pp., illus. 1958. $4.00.*

CHANGES IN URBAN OCCUPANCE OF FLOOD PLAINS IN THE UNITED STATES. *By* GILBERT F. WHITE, *et al. The University of Chicago, Department of Geography. Research Paper No. 57, 235 pp., illus. 1958. $4.00. (Both books reviewed by* WALLACE E. AKIN, *Drake University, Des Moines, Iowa.)*

These two volumes are noteworthy contributions to the literature on water resources, and are a "must" for anyone dealing directly with flood problems or urban planning and zoning. City officials in almost any capacity, and business and industrial leaders would benefit from these carefully documented reports on our failure to recognize and deal with flood problems realistically at the national and local level.

The first volume by Francis C. Murphy undoubtedly is the most thorough study to date on the flood-plain zoning and regulation in this country. The author critically analyzes actual administrative procedures for flood-plain zoning in use today, and has made extensive field investigations of the areas where regulations are in force. The study is divided into three sections: Chapter I explores the logical role of regulatory methods in an integrated approach to flood-damage reduction: Chapter II analyzes the methods of regulation now in use and points out the strengths and weaknesses of each; and Chapter III examines the conditions under which flood-plain regulation may play a part in future efforts to minimize flood losses.

The second volume by White and five other authors explores the changes in urban occupance of flood plains in the United States since the enactment of the Flood Control Act of 1936, which was for the expressed purpose of reducing the annual flood loss through engineering and land treatment. By a careful study of selected urban areas for the 1936-1957 period, the authors conclude that "insofar as urbanized flood plains were concerned, the areas of potential damage clearly expanded."

Particularly interesting are the case studies of 17 urban communities from coast to coast in which flood-plain encroachments are studied and the attitudes of the governments, businessmen, and citizens are explored. After reading this report, the reviewer is aware of the discouraging tendency of civic leaders, businessmen, and citizens to minimize flood dangers, to place dependence on vague assumptions of miracles in flood control through engineering works or land treatment, and to look to the federal government for subsidies to take care of any difficulties brought about by their short-sighted encroachment on the flood plains.

THE ECOLOGY OF INVASIONS BY ANIMALS AND PLANTS. *By* CHARLES S. ELTON. *John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 181 pp., 50 plates, 51 text figures, refs., index. 1958. $5.25. (Reviewed by* D. E. WADE, *Des Moines, Iowa.)*

Charles S. Elton, a Britisher, has again demonstrated that he is one of the world's great ecologists. Many readers know his book, *Animal Ecology* (1927), which is a classic. Fewer know his exciting book, *Voles, Mice and Lemmings* (1942), or his radio broadcasts in book form, *Exploring the Animal World* (1933).

Now, in *The Ecology of Invasions*, the director of the Bureau of Animal Populations at Oxford, has brought together in concise, meaty and witty form "ideas from three different streams of thought": international streams of faunal history, ecology, and conservation, with which Elton has been concerned for more than 30 years. The result is another Elton superlative which will lead to an "invasion" of his thoughts—so we hope—among conservationists worldwide.

Sir Charles is not only a scholar, but an organizer and a tantalizer. He has dug into facts worldwide and his every paragraph in all his writings bristles with ideas, facts, and theorizing. You can race through this slim volume on a first reading, but you soon discover that this book begs for repeat readings.

Elton has written about "ecological explosions". Some of these have developed slowly yet are impressive in their full force—influenza, bubonic plague, the potato fungus that hit Ireland, chestnut blight (America, Italy, Spain), rabbit disease (myxomatosis). Or consider the sea lamprey (*Petromyzon marinus*) which, in 1829, with the completion of Welland Canal, gained ingress to Lake Erie. About 100 years later the lamprey "explosion" (invasion) had reached a violent stage with virtual collapse of many valuable fisheries throughout the Great Lakes.

Rich fare indeed are the chapters of Elton's latest book: *The Invaders; Wallace's Realms: The Archipelago of Continents; The Invasion of Continents; The Fate of Remote Islands; Changes in the Sea; The Balance Be-*

tween Populations; and *New Food-Chains for Old.* But Elton has gone beyond the conservatism of the British and injected two closing chapters: *The Reasons for Conservation* and *The Conservation of Variety.*

American conservationists will find a refreshing viewpoint in these closing chapters. However, conservation has become a splintered term in America. What Elton has to say may aid in bringing American conservationists of all sorts back onto a common track of effort and definition. Elton injects religious, aesthetic, intellectual and practical reasons as measures for insisting that all of us be concerned with conserving a rich variety of nature. The "mono-cultural" tendencies of many brands of conservation in America have ignored or passed over lightly this matter of "conserving a rich variety of nature."

Elton has searched hard for "some wise principle of co-existence between man and nature, even though it has to be a modified kind of man and a modified kind of nature." This is, in effect, what he feels is conservation.

In his closing chapter, Elton quotes from an International Union for Conservation talk in which Edward H. Graham states: "There should be additional evaluations of ecological inter-relationships on areas devoted exclusively to nature and on areas under other types of use, as farming, ranching and forestry." Elton follows with some sage recommendations that, "From now on, it is vital that everyone who feels inclined to change or cut away or drain or spray or plant any strip or corner of the land should ask themselves three questions: what animals and plants live in it, what beauty and interest may be lost, and what extra risk changing it will add to the accumulating instability of communities."

It appears that an environment made monotypic by the actions of mankind and lacking in variety and beauty may be a sitting duck for almost any kind of an ecological explosion, or other kinds of invasion. It appears that Charles Elton has opened the door a bit wider on the beginnings of some very fundamental conservation.

How much more that door is opened depends upon all brands of conservationists: How quickly the mental shackles of "pet" technologies can be shaken and whether or not we can each gain something in common of the cosmopolitan understanding of conservation that Elton has tried to think through in *The Ecology of Invasions.*

ENVIRONMENTAL CONSERVATION. *By* RAYMOND F. DASMANN. *John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 307 pp., 153 figures, references for each chapter, index. 1959. $6.50. (Reviewed by* D. E. WADE, *Des Moines, Iowa.)*

Conservation textbooks are improving and this aptly describes Dasmann's book. Conservation is defined by him as "the use of natural resources to provide the *highest quality of living* for mankind. It must aim toward both a material and a spiritual enrichment of life for man on earth, now and in the future." (Emphasis is the author's.)

After laying down some definitions and outlining some fundamental principles, Dasmann moves on rapidly to describe the major biotic regions of the world; followed by "Man's Record on the Earth." In the next six chapters there is a broad but satisfying portrayal of man's dealings with agricultural lands and soil conservation, water, forests, range, wild animal life, and fisheries—the traditional approach.

The next two chapters discuss "The Conservation of Environments" and "The Problems of Population." Here Dasmann brings out strongly his major theme: "Each natural region [must] be regarded as an organic whole and developed to provide an optimum habitat for man": due consideration must be given to the *whole* spectrum of land and land-use patterns—from the highly industrialized cities to the wilderness. Obviously, in view of this approach to conservation, we must admit that our efforts to date are in their infancy. But, make no mistake, Dasmann is advocating the finest approach to conservation recognized today.

Likewise there are ethics of high order in applying "environmental conservation" and Dasmann does well in outlining this. America is still young and growing, but can ill-afford not to give serious attention to and apply as quickly as possible the principles elucidated in this book. The alternative is to plunge ever-deeper into the lecherous and consuming pit of unbridled growth and development. The final chapter, "Outlook," is most stimulating and refreshing.

Environmental Conservation may well be acclaimed as one of the best among conservation texts. It certainly contains the startling revelation that perhaps there is, via the course of "environmental conservation," some hope after all for the salvation of mankind.

FUNDAMENTALS OF ECOLOGY. *By* EUGENE P. ODUM, *in collaboration with* HOWARD T. ODUM. *W. B. Saunders Co., W. Washington Square, Philadelphia 5, Penna. 546 pp., illus., 160 figs., 32 tables. 2nd ed., 1959. $7.50. (Reviewed by* BEN OSBORN, *Washington, D. C.)*

A new and enlarged edition of Odum's *Fundamentals of Ecology* updates this basic treatise to keep pace with progress in the physical and biological sciences and to recognize new problems in resource conservation.

A chapter on the important new subject of radiation ecology has been added, and new material has been inserted at many points through the text. Discussion of some of the basic concepts has been elaborated.

The book follows the pattern of the original edition published in 1953. This is a wise choice, for the unique organization of that book helped win it a prominent place among general ecology texts. Especially effective is the device of treating theory as a series of well-defined concepts, each first presented as a *statement* of the concept, then elaborated in a *discussion*, and finally illustrated by a number of examples.

The first and largest part of the book (287 pages) is devoted to some 50 major concepts separately stated and discussed under the general headings of: (a) the ecosystem and biogeochemical cycles, (b) energy in ecological systems, (c) limiting factors, (d) species populations, (e) interspecies populations, and (f) biotic communities. A number of subsidiary concepts are introduced.

This organization provides a framework within which the reader can file almost any bit of information he may have about life and its physical environment. Each segment of the physical and biological sciences helps to explain the "metabolism of the ecosystem" or to illuminate some corner of the natural world within the purview of ecology. Any specialist in the field of agriculture and resource conservation—be he agronomist, soil scientist, hydrologist, geneticist, atomic chemist, or whatever—can find satisfaction in seeing the relation of his work to the ecological system as a whole.

This approach breaks away from the rigid viewpoints of classical compartmentalized biology. The emphasis is on the functioning of the ecosystem (i.e., living organisms of an area and their physical environment considered as an entity) rather than on the growth requirements of individual organisms or species (autecology) or the association of species into communities (synecology) that largely dominated earlier ecology texts. We are concerned here with the biomass (total living matter of whatever kind), with the transfer of matter and the flow of energy, with food chains and production rates, and with the various phenomena of population controls. The identifying and naming of organisms and communities, activities that have occupied much attention of ecologists in the past, are here regarded as incidental matters, important mainly as tools useful in analyzing and understanding the ecosystem.

This functional approach opens new horizons in ecology and resource management, much as modern developments in the physical sciences have launched us into the new era of electronics and nuclear technology. We begin to see the possibilities of manipulating matter and energy —going beneath the gross units of species and communities—to produce organic materials of most use to man. At the same time we are cautioned that such "management" of resources can succeed on a continuing basis only if skillfully fitted into the larger picture of biogeochemical cycles and energy balance.

Part II of the book (pages 289-418) describes the physical environments and biotic communities of the principal habitats of the world, grouped as fresh-water, marine, and terrestrial. Where Part I concerns itself with function, Part II emphasizes structure—that is, how nature "looks." Part II, through cross-reference to the concepts set forth in Part I, illustrates abstract theory with concrete examples.

The final section of the book, the shortest (pages 419-496), deals with the applications of ecology to practical matters. This book does not attempt to detail the methodology of agriculture, conservation, and other fields concerned with the use and management of plants and animals, for, as the author correctly points out, there is a separate and voluminous literature on these technologies. Instead, this final part strives to show the connection between the concepts and principles of ecology and the practices through which they are applied.

Naturally, the author's own viewpoints and philosophy show most clearly in this final section. He joins in the modern concept of conservation as a means, not of hoarding static supplies to ration them for the future, but of managing them "to insure a continuous yield of useful plants, animals, and materials by establishing a balanced cycle of harvest and renewal."

Conservation, he says, is the most important application of ecology, and the ecosystem is the most important principle of conservation. He is one of the first to question the accepted classification of resources as "renewable" and "nonrenewable." Sources of minerals and energy, he points out, are renewed through the biogeochemical cycles and "man need never lack vital materials so long as these cycles operate in such a way that materials as well as organisms are 'assembled' as fast as they are 'dispersed'."

Special applications of ecology are discussed with respect to agriculture and forestry, land use, wildlife management, pond management, larger impoundments, stream pollution, marine fisheries, range management, and public health and welfare.

The largest portion of new material in this section is the chapter on Radiation Ecology. It includes a review of nuclear concepts and terminology important in ecology, a survey of what is known about the comparative sensitivity of organisms to radiation and the fate of radioactive isotopes in the environment, and discussions of the fallout and waste-disposal problems. This is a good general introduction to the subject, but the reader must bear in mind that this is a new and rapidly developing field and a textbook chapter completed months before publication cannot have the benefit of the latest information.

The relation of man to the ecosystem and the prospect of the effect of his future population on the resource base

are examined in the final chapter. We find here a moderate viewpoint, aligning best perhaps with the "optipessimists" who recognize that we have serious problems but who do not agree that they are beyond our capabilities.

The author suggests that if Malthus had understood some of the ecological principles learned since his time, he might not have painted such a grim picture of man's future. But rather than condemning Malthus, Odum credits him with clarifying an important principle of population growth that takes its place along with several others in his chapter on species populations.

We are warned also against being beguiled by the notion that man can create an entirely new order, dominated by his intellect and replacing the natural ecosystem. Referring to this idea, a footnote on page 26 says: "When the reader has finished with this book I am sure he will agree that we have much to learn before we can safely take over the management of everything!"

As he sums it up in the final chapter, "Populations of men, like other populations, are a part of larger units, i.e., biotic communities and ecosystems. Although man greatly modifies many of these units of which he becomes a part, he does not 'create' them and is dependent on them, as is any other organism."

The kind of knowledge and understanding contained in *Fundamentals of Ecology,* extended as it must be by continuing research, will enable man to meet his future needs without wrecking the world in which he lives.

The book has a copious bibliography including not only the references cited in the text but basic readings in the many supporting sciences. A modernized typography makes the new edition more legible than the first.

Recreational Use of Wild Lands. By C. Frank Brockman. 346 pp., illus., selected references, index. 1959. McGraw-Hill Publishing Co., 330 West 42nd St., New York 36, N. Y. $8.50.

As the latest volume in the McGraw-Hill American Forestry Series, Brockman's book will have much use as a college text. Due to the prodigious combing of U. S. and world literature on the subject, and the author's field experience, it will be a long time before another similar publication is produced. In most ways, this book will become known as the "classic" in its field. The publication is well-prepared and an excellent reference. The index is very thorough.

The volume affords an introduction to the varied concepts of recreational wildland use. The recreational uses of wildlands are now an established part (a requirement) of modern life in the United States and Canada. Brockman's book will also be read and studied outside the classroom, especially by those responsible for administration of wild-lands and zoning. The author is a professor of forestry at the University of Washington.

Serve By Conserving. By Jack Cox. 157 pp., illus. 1958. Published by The Boy Scouts International Bureau, Commonwealth Bldg., Metcalfe St., Ottawa, Canada. (Price not given; restricted distribution.)

A review of this restricted publication was prepared by O. M. McConkey of Guelph, Ontario, and appeared in the "World Scouting Magazine" of December 1958. Cox's book deals with the study of nature and conservation and is a handbook for Scouts internationally. It was published with the aid of UNESCO. A second edition is scheduled soon. For further information on this "commercial" edition write The Boy Scouts International Bureau at address given above.

Good Fishing: How to Maintain and Improve the Sport. By R. W. Eschmeyer and George S. Fitcher. (Illus. by Ed Zern.) 124 pp., illus., index, Epilogue: R. W. Eschmeyer, 1905-1955. 1959. Harper & Brothers, 49 East 33rd St., New York 16, N. Y. $2.95.

The late R. W. Eschmeyer, one of the greats in the fisheries field, was no slouch at pulling punches or in writing. His famous "True-To-Life" books, aimed at youths, but read by all ages, attest to his writing skills. Now using a manuscript started by Eschmeyer, George Fitcher has completed another Eschmeyer item.

Probably in no other publication will a reader find as easy to read a presentation of the concepts of modern freshwater fisheries management. This is the sort of book that every fish and game commissioner in the country should own and study and follow.

The authors vigorously and repeatedly point out the best way to make fishing better is to pay better attention to good land management and use. They know, from first-hand experience, the bad effects upon fisheries that come from poor land management—silt, soil erosion, overgrazing, forest fires, etc. Because the book is easy to read, short, inexpensive and authoritative, it will be widely read not only by technicians and sportsmen, but by the general public, including students in high schools and colleges.

Water: Riches or Ruin. By Helen Bauer. 121 pp., illus., list of words to know, index. 1959. Doubleday & Company, Inc., Garden City, N. Y. $3.00.

Although largely based on California facts, this book will have universal appeal to readers from the 6th grade and up. The presentation is straight forward, but avoids mention of controversies that have characterized much of the water development in California and the Southwest. Definition of conservation and scant mention of fisheries and fishing (recreation) seem to be the two weaknesses. Otherwise the interdependencies of use of other resources (soil and plants) and human beings of water are covered.

The reader gets many suggestions as to how he as an individual or through groups can help in conserving water, soils, and forests. Certainly the reader obtains a good understanding of how California has and expects to obtain water supplies.

To the young reader of this book, it may come later as a shock to realize water-use allocations do change and are often the subject of great debates. How to establish a system of free inquiry and criticism, *starting* with young readers, is a collateral question that arises from a reading of "Water: Riches or Ruin."

And History Is Already Shining On Him. By Santford Martin. 15 pp., reprinted from *Better Crops with Plant Food Magazine,* Reprint D-1-59. Distributed by The American Potash Inst., Inc., 1102 16th St., N. W., Washington 6, D. C.

A fine resume of activities of Hugh Hammond Bennett, soil conservation leader and one of the founders of the SCSA.

News Notes

SECRETARY'S COLUMN

Using 1945 as a starting date the Soil Conservation Society of America has grown at the rate of 53 new members a month since that time. Actually a few people first paid their dues in 1944 but it was not until 1945 that the big membership drive really started.

Membership growth, year by year, is indicated on the adjoining chart. On December 31, 1958, the membership was 9,357.

Each year a comprehensive membership report is compiled for the annual meeting. On August 1, 1959, the membership was 9,410. It should exceed 10,000 before the end of the year. Since figures were compiled for the annual meeting at Asheville, the Society has secured 2,270 members but during the same period 1,392 failed to renew their membership to cut net gain.

On August 1, North Carolina continued to hold the lead in membership with 456 but was closely pushed by South Dakota with 428. South Dakota led in the number of new members with 211. During the past 11 months membership has increased in all except 16 states and in only four states has the loss been significant.

A new membership accounting system has been adopted in the past year.

* * *

This is being written just prior to the 14th annual meeting. Over 1,000 reservations, including families, have been received and all indications point to another outstanding conference. The members of South Dakota Chapter, while saddened by the death of Ross Davies, have worked diligently to have all in readiness for the convention visitors.

* * *

The Soil Conservation commemorative postage stamp is bringing considerable publicity to the soil conservation movement, to the work on the land, and to the Soil Conservation Society of America. We are pleased the Society meeting was selected for its introduction.

The membership, the convention, the activity in regard to the postage stamp are only a small part of the Society's program. More than 100 chapters are now active and have programs that are growing in strength each day. The parent Society has 30 committees working on organizational and soil conservation problems. We will attempt to report their activities from time to time—some of the reports have already appeared in the JOURNAL. Others will be presented at the annual meeting and through local chapters.

Latest activity is the production of **Dennis the Menace and Dirt.** Soil conservation will never be the same again. We are indebted to Caterpillar Tractor Company for purchasing the first 200,000 copies—and of course, to Hank Ketcham and his staff, and to Hallden Publications, Inc. for their cooperation in getting the booklet in production.—H. WAYNE PRITCHARD, *Executive Secretary.*

FUTURE ANNUAL MEETINGS SCSA

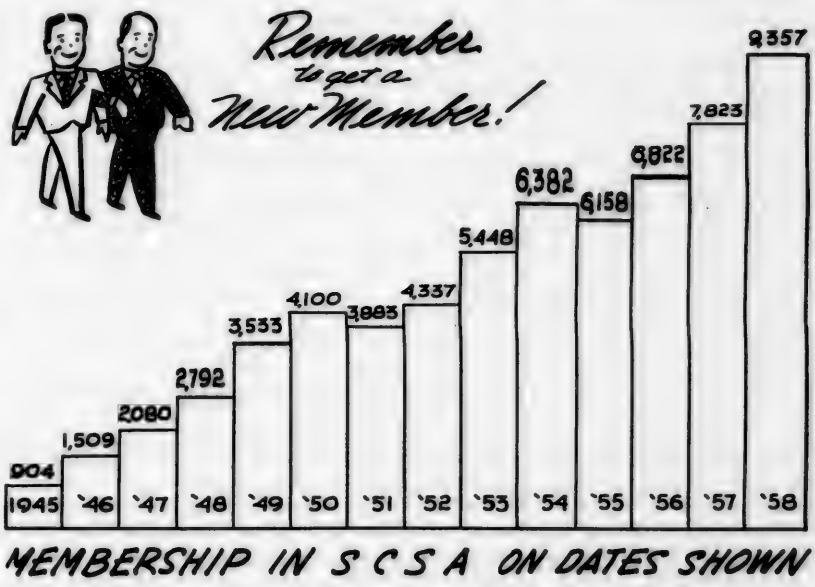
The Council of SCSA has set the following dates and places for future annual meetings of the organization:

August 28-31, 1960—Ontario Agricultural College, Guelph, Ontario, Canada

July 31-August 3, 1961—Purdue University, Lafayette, Indiana

August 26-29, 1962—Sheraton Park Hotel, Washington, D. C.

The Council has further determined that the 1963 annual meeting will be in the Western Region although no exact place has been stated.



OFFICERS AND COUNCIL OF SCSA, 1959. Front row, left to right, Elmer L. Sauer, 1st vice-president; Alvin C. Watson, president; Howard F. Barrows, treasurer; Russell G. Hill, immediate past-president; John W. Barnard, Northeast region representative. Back row, left to right, Minott Silliman, North Central region; H. G. Bobst, Great Plains region; Herbert A. Hopper, Western region; H. Wayne Pritchard, executive secretary. Missing from photo are Walter C. Gumbel, 2nd vice-president; E. D. Bolton, councilman-at-large; A. H. Veazey, Southeastern region; Firman E. Bear, at-large; and Harold M. Rhodes, at-large.

SCSA STUDENT CHAPTERS AND BRANCHES

The Soil Conservation Society of America launched its student program in 1951 with the founding of the first *student chapter* at the University of Nebraska. Since then, the Society has chartered student chapters at California State Polytechnic College, the University of Michigan, Rutgers University, Texas A & M College and Northwestern Michigan College. The Texas A & M and Northwestern Michigan College chapters are currently inactive.

Following the revision of the Society's Bylaws last year, the Stillwater Chapter and the Northern Illinois Chapter organized *student branches* at Oklahoma State University and the University of Illinois, respectively.

Each student chapter or branch has to find its own niche in the extra-curricular environment of the campus. Each has to develop its own type of program based on the interests of members and the opportunities available. The only generalization which can be made about the student groups is that they are all dependent on the interest and active support of faculty and Society members. All student groups are up against stiff competition for the extra-curricular time of members. Even the best in student leadership cannot succeed unless it has support in finding and making the most of its opportunities. It is the responsibility of SCSA professional members to provide this support.

Basically, student chapters and branches serve two major functions: education and professional association. An extra-curricular program provides a chance to learn some things not specifically taught in the classroom as well as to put to use academic teachings. One of the main reasons students join the Society is to receive the JOURNAL with its fine articles of professional and general interest. Association with working conservationists is important to students in finding the ways into the professon and its many ramifications.

Education and recruitment are goals of any profession. The Society and each of its chapters has a great opportunity to accomplish these goals through student chapters and student branches at institutions of higher learning.

There are many members of the Society who are willing to work with the existing student groups and would like to help get others started. The problem is that the students often don't know who these people are. Student chapter or branch committees should be an active part of the program of every professional chapter. Student chapters want to maintain their autonomy, but they also want to be a functioning part of the SCSA program in their states.

The seven active student chapters and branches have developed strong successful programs which are a credit to the Society. This is what they have been doing:

University of Nebraska Chapter, Lincoln, Nebraska.
Officers: President — Norman Rohlfing; Vice-President—Eldean Ferloff; Secretary—Gary Williams; and Treasurer—Morris Beerbohm. *Members:* 35 seniors and juniors, 15 sophomores and freshmen.

Chartered in 1951 under the sponsorship of the Lincoln Chapter, the chapter affiliated with the University Agronomy Club when it was organized in 1955.

Meetings are held twice a month with speakers selected from professional agronomists and conservationists in the Lincoln area. The student chapter and the Lincoln Chapter have joint program meetings once a month on the meeting night of the professional chapter. The student committee of the Lincoln Chapter has helped organize the joint meetings which provide an opportunity for students to meet and learn about the work of the professionals.

The chapter has participated in various activities such as creating floats for parades, organizing student soil and crop judging contests, and cooperates with the Agricultural Executive Board in sponsoring campus events.

California Student Chapter, San Luis Obispo, California.
Officers: Chairman—Sidney Siemer; Secretary-Treasurer—Robert Wendt; and Advisor—Dr. Logan Carter.
Members: 30 seniors and juniors.

Student initiative with the full support of the Soil Science staff at California State Polytechnic College was responsible for the organization of this chapter in 1952.

Monthly meetings are held to hear professional conservationists and to plan the activities of the chapter. Joint meetings are held with other campus groups in which the chapter sponsors or arranges for a speaker of note to meet large numbers of students and faculty.

In 1953, the Chapter initiated a program of land judging in nearly all California high schools. This led to the development of state-wide contests for FFA groups. Each year the Chapter conducts three or more sectional contests throughout the state in addition to the state final. The contests involve all chapter members in the preparation for and actual conduct of the contests. Chapter members also do a great deal of traveling to high schools to stage demonstrations.

University of Michigan Chapter, Ann Arbor, Michigan.
Officers: Chairman—Robert Twiss; Secretary—Phyllis Wells; Treasurer—Charles L. Hudson; and Advisors—Dr. Stanley A. Cain and Dr. Richard L. Weaver. *Members:* 19 graduate students and 4 seniors and juniors.

A group of students in the UM Conservation Department, who had been meeting informally to discuss conservation problems, formed a student chapter in 1954 with the backing of the department faculty.

Weekly meetings are held in which the many aspects of conservation are discussed. For speakers, the chapter draws frequently from its own membership, the general University faculty and members of the Michigan SCSA Chapter. The student chapter has sponsored campus-wide lectures and symposia on conservation featuring visiting specialists, and held occa-

STUDENT SCSA CHAPTER MEMBERS AT THE UNIVERSITY OF MICHIGAN DISCUSS CONSERVATION PROBLEMS WITH A PANEL OF FACULTY MEMBERS OF THE SOCIETY AT ONE OF THEIR WEEKLY MEETINGS.

sional joint meetings with other groups. Chapter members frequently serve as resource persons to schools, school camps and youth organizations.

The chapter has established the Samuel T. Dana Award in Conservation to be granted to a student at the University of Michigan who exhibits high scholarship and professional promise in the field of conservation.

A close relationship is maintained with the Michigan Chapter by having a student chapter member participate in the meetings of the Michigan Chapter's executive council. Chapter members attend the meetings of the Michigan Chapter, and on one occasion they sponsored such a meeting.

At the suggestion of the student chapter, the Michigan Chapter provided funds to send 500 copies of the Spanish edition of *"Story of the Land"* to Mexico City for use in the public schools. Another cooperative undertaking was the successful nomination of student chapter advisor Dr. Stanley A. Cain as a Fellow of the Society.

Rutgers University Chapter, New Brunswick, New Jersey.

Officers: Chairman—Harry Mumma; Vice-Chairman—Barry Clark; Secretary-Treasurer—Peter Buell; Advisor—Dr. Robert Hanna. *Members:* 28 graduate students, 12 seniors and juniors, 7 sophomores and freshmen.

The chapter was organized under the sponsorship of the New Jersey Chapter in 1954. Inactive for several years, it was reactivated in 1957. By talking with students in the fields of soils, crops and conservation and by notices on all agricultural campus bulletin boards, interested students have joined.

Meeting twice a month, the chapter alternates its programs between a speaker or movie and a business meeting. Occasional joint meetings are held with the agricultural engineering group.

An open house for most of the departments in the School of Agriculture was sponsored by the chapter during the Agricultural Field Day, and a chapter float was entered in the Field Day parade.

During the 1959 National Wildlife Conference, the chapter at Rutgers conducted a special SCSA program on Conservation and Wildlife. Following a keynote address, a panel of chapter members discussed research which they were conducting. At the SCSA 1958 annual meeting in Asheville, the chapter made several tape recordings for use on radio in New Jersey.

The New Jersey Chapter has an active student chapter committee which works closely with the Rutgers Chapter. The student chapter advisor is a member of this committee.

Oklahoma State University Student Branch, Stillwater, Oklahoma.

Organized in 1958 by the Stillwater Chapter, the branch has a membership of 17 seniors and juniors. Student members are invited to participate in the meetings of the Stillwater Chapter, and the student committee of the professional chapter works with the student members.

University of Illinois Student Branch, Urbana, Illinois.

The Northern Illinois Chapter organized the branch in 1958, and the student committee has been active in working with student groups at the University. A land judging contest was organized, with the winners representing the University in the Midwest regional contest. The committee also conducted a tour of the local Soil Conservation District and organized demonstrations of engineering and other conservation practices.—BERNARD L. CLAUSEN, *Chairman, Student Chapter Committee, SCSA, Ann Arbor, Michigan.*

SCIENCE FAIRS AND CONSERVATION

HIGH school and junior high students all over the Nation each year demonstrate great dexterity and ability in crowding Science Fair halls with their exhibits.

How many members of the SCSA have attended a Science Fair and marveled at the ingenuity of the student exhibitors? How many SCSA members have further examined a Science Fair to determine the kinds of exhibits?

Recently it seems that missiles, electronics and Hi-Fi have captured the imagination of the student. Conservation exhibits are often lacking or poorly presented. This was brought to the attention of the Washington, D. C. chapter by Harold B. Owens, supervisor of Elementary Training for the Prince Georges County Schools in Maryland.

That there can be glamour to conservation projects in Science Fairs is the belief of the Washington, D. C. chapter. To prove this, committees of the chapter visited the five Science Fairs in the D. C. metropolitan area. Each committee selected the project or projects which they believed were the best example of the conservation theme.

The students and teachers responsible for these exhibits then received a letter of commendation from the chapter president. Arrangements were also made by the chapter for the students and teachers to meet with Secretary of Agriculture Ezra Benson and discuss their conservation theme. Following this meeting, the students and teachers were guests of honor with the Washington, D. C. chapter as host.

The students and teachers showed enthusiasm and appreciation for what had been done for them, especially since this was the first time any recognition had been given to any student in the area for using a conservation theme.

The teachers promised to obtain more attention to the conservation theme at future Science Fairs.

The winners and the teachers of the first conservation awards in the metropolitan area of Washington, D. C., were as follows:

William Ingrum and Susan Laurie Abrams, Williamsburg Junior High School, Arlington, Virginia. Their teacher was Mrs. Dorothy Culbert.

Samuel Merrick Patton, Jr., Jefferson Junior High School, Alexandria, Virginia, and his teacher was Mrs. Frankie Jo M. Torby.

Marilyn Louise Simmons and Eric Bill Haegele of Hyattsville Junior High School, Hyattsville, Maryland, and their teacher was Miss Marjorie Hackett.

Sue Hengren, Bloom Junior High School, Rockville, Maryland, and the teacher was Robert Von Nasson.

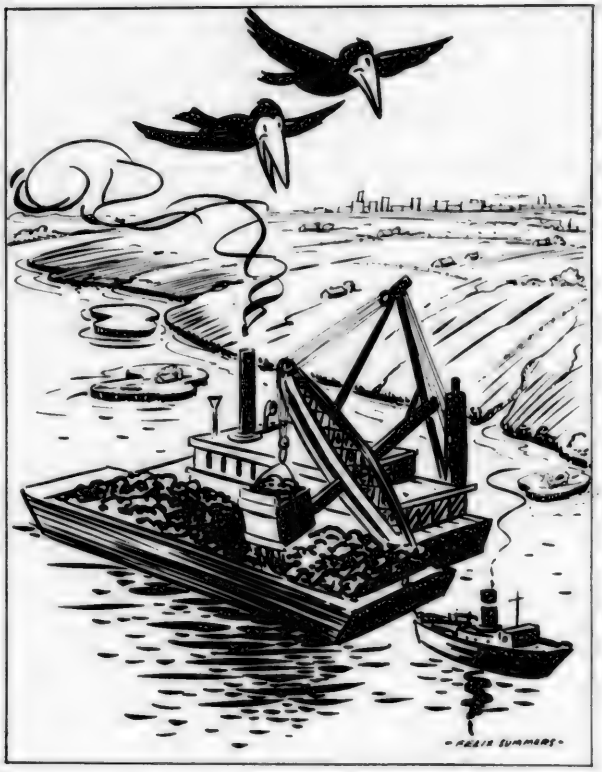
Alvin Sussman of Paul Junior High School, District of Columbia, and his teacher was Dr. Bernice Lamberton.

At the Science Fair awards dinner, the over-all program was explained by committee chairman Joe Wagner; other speakers included Russell Hill, past-president of the SCSA, Fair Griffin, John Barnard, and several committee chairmen of the chapter.

The chapter has a committee at work preparing a "conservation" addition to a Science Fair publication which will be given national distribution. The chapter planned to distribute advanced copies of this "conservation" section at the SCSA meeting in Rapid City, South Dakota.

Was the Washington chapter the first chapter in the Society to make awards for conservation projects and exhibits at Science Fairs? If it was not, how about a letter or notice to the Journal to inform what other chapters had been experiencing with these Science Fairs. The Washington, D. C., chapter would like to challenge other chapters to do the same at Science Fairs in their areas for the coming year.—JOE WAGNER, *Washington, D. C., No. 1 Chapter.*

SOIL "CONVERSATION"



"Whose farm are they dredging now? Looks like 'Rob Peter, pay Paul!' "

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"PARKERIZED"
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CHAPTER NEWS

The news on the two **Alabama Chapters** might best be described by quoting from a letter written by Harold Benford, president of the North Alabama chapter:

"You will be interested to know that activity in the two Alabama chapers of the Society as well as the SCSA is at the highest point right now that it has ever been. We have just completed our 6th annual meeting July 31 and August 1.

"We had the best attendance yet, which was 132; and we had the best program we have ever had, along with the best newspaper, radio, and TV coverage we have ever had. The whole program and meeting seemed to be teeming with new thought and vitality. . . . We feel now that our Alabama chapters are on the way toward developing a real interest in soil and water conservation through the program of the SCSA."

Some of the speakers at this fine meeting in Alabama were Ben G. Lanhan, head, Department of Agricultural Economics, Auburn; Harry Donavan, branch manager, International Harvester Company, Birmingham; Vance R. Miles, vice-president, Gulf State Paper Corp., Tuscaloosa; Claude D. Kelly, president of Wildlife Federation, Atmore; and Dr. E. T. York, director of the Alabama Extension Service, Auburn. The program covered a wide variety of interests: agriculture, mechanization, forestry, wildlife, and recreation.

Hoosier Chapter (Indiana) is now getting up steam to host the 16th annual meeting of the SCSA to be held at Purdue University in Lafayette, Indiana, during the summer of 1961. In order to more thoroughly understand the intricate details of running an annual meeting, there was a large contingent from Indiana present at Rapid City.

The latest newsletter (No. 16 in a series) contained some good information on the minimum tillage demonstration which was held on the Hugo Bulmahn farm in Adams county on May 19 and attended by 300 persons. Bulmahn, incidently, hitches a conventional two-row cornplanter to the *side* of a tractor. His tractor also pulls a 3-14-inch bottom plow. A second tractor pulls a similar plow alone. Bulmahn attaches a small strip tillage tool to each plow. It slices and levels the furrow to be planted. There's a complete absence of tractor wheel marks on the fresh plowing, only planter wheel marks.

A fall meeting of the chapter is planned for Perry county in October. The session will feature "rural developments".

Northern Illinois Chapter held a successful meeting at the McKay farm near Cordova on the Mississippi River. Claire Golden, a local farmer and hybrid corn producer, in his talk said that some 40 years ago he based a college thesis on the study of the sand lands of Cordova township. He made many comparisons between farming of that time and today's conservation programs.

With June Silliman and Reece Ayers serving as chefs and arrangers the executive committee of the chapter met at Kankakee State Park to see the progress of the demonstration project which the chapter is sparking. About all that is needed to complete the picture is water in the newly-created pond.

The latest newsletter (No. 14) had a brief item on "Do you read the ads in the Society's Journal?"

The Salina Chapter (Kansas) held an irrigation tour June 5 on the Kelvin Hobson farm with 41 members and guests present. A sack lunch was enjoyed at the Lovewell Reservoir. John Daniel, Bureau of Reclamation, told the group many facts about the Reservoir and irrigation.

The September 4 meeting was held at Lincoln, Kansas, to view the Lost Creek Watershed, which is nearing completion.

Old Line Chapter (Maryland) mixed pleasure with conservation at Ocean City on July 26. Dr. A. A. Hanson, ARS, spoke on grass and its importance in the conservation program. "Augie" Augustine presented a slide discussion on shore erosion.

The chapter's investment of $100 in a scholarship has helped to fill a summer conservation course which had 25 teachers registered. The workshop was held at the University of Maryland under the guidance of Byron Ashbaugh of the State Department of Research and Education.

In a unique departure from the usual kind of meeting, the chapter in early summer sponsored a series of five county meetings. The largest attendance was in Prince George county with 75 where Congressman John R. Foley was the main speaker. In Washington county a tour was held to observe conservation practices in orchards. About 50 people participated in the tour.

The Old Line chapter collaborated with the Washington No. 1 chapter in working out an exhibit which was placed in the Statler Hotel during the National Watershed Congress in late May.

THE NEW BANTAM C-350

...it's sized right and built right for soil and water conservation work

The all-new BANTAM C-350 crawler combines fastest digging ability with true job-to-job mobility. Its high production assures more channels cleared, more miles of ditch dug, more ponds and more reservoirs built per season! Its compact, practical size gives you faster moves between jobs with travel over highways permit-free.

When you swing into a job with a BANTAM C-350, you immediately discover its surprising work speed and easy operation. The C-350 gives you fast-cycle operation because of its advanced, balanced design; the use of anti-friction bearings throughout, and its rugged power. And the C-350 is easier to operate because of its foolproof mechanical controls that defy heat, cold and moisture.

You can work anywhere with a C-350 BANTAM crawler. Its ground bearing pressure is low—2½ lbs. p.s.i. when using 32" pads and long side frames. Result: you can work rapidly in wet, mucky ground without matting. BANTAM goes where no other machine with its capacity can work so effectively.

The BANTAM C-350 is versatile—offering the widest choice of job-matching equipment. It works and earns with 11 BANTAM-built attachments—plus new special-design "V" bucket that gives up to 400' of 3½' ditch per hour! Try the all-new BANTAM C-350 before you buy. Call your BANTAM distributor today for a free on-your-job demonstration.

SCHIELD Bantam Co.

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306 Park Street, Waverly, Iowa

Send information on soil and water conservation work with: ☐ crawler mounted BANTAM C-350, ☐ carrier mounted BANTAM T-350, ☐ self-propelled BANTAM CR-350.

Name_____

Title_____

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WORLD'S LARGEST PRODUCER OF TRUCK CRANE-EXCAVATORS

Iowa Chapter, Area 1, held a summer outing at Lake Okoboji. Dr. R. L. King of the State University of Iowa, in charge of the Lakeside Laboratory on Okoboji, spoke informally before the family group. The Iowa chapter continues to press its 2nd annual photography contest project scheduled to end the middle of September.

Washington, D. C. Chapter No. 1, although it does not hold monthly meetings during the summer, nevertheless continues to be active through committee work. This summer committees are at work on science fair awards looking forward to junior high and high school science fairs in 1960; promotion of conservation exhibits; chapter activities; chapter in science fairs resource book; delegates to annual meeting in Rapid City; conservation education; 1962 SCSA annual meeting; public relations; recruitment; Rock Creek Watershed; conservation tours; Journal advertising; commemorative stamp; and sale of SCSA booklets.

L. R. Bereuter and Bob Branstead collaborated with the Old Line chapters of Maryland in preparing a science exhibit display for the Watershed Congress, which was held the last week of May.

The No. 1 chapter, in cooperation with the District chapter of the American Society of Range Management, is preparing a chapter in a source book on science fair exhibits: Some 50 suggestions for science fair conservation exhibits were included. Duke DuMars, chairman of the conservation tours committee, has a conservation tour map 17 x 22 inches prepared. The committee is now exploring the possibilities of interested oil companies which might include on their own maps the conservation tour information which is related to the greater Washington area.

There is a great deal of talent in the Washington D. C. No. 1 chapter. It is obvious the members are busy at work on some very rewarding chapter projects.

THE LOW-COST WAY TO HOLD STRAWY MULCH IN PLACE

. . . BEMIS WIDE-WEAVE OPEN-MESH!

Here is your effective answer to a major problem—keeping strawy mulch in place on highway or soil conservation projects . . .

It is economical—costs less than 4¢ per square yard.

It is easily applied—just unroll over the mulch and secure with wire staples or stakes; fabric is 45 inches wide.

It is long-lived—made of rugged twisted paper, it will last a surprisingly long time, particularly when applied over mulch.

And note the surprisingly low cost:

1,000 linear yard roll (1,250 sq. yds.) —$49.50, freight prepaid.

2,000 linear yard roll (2,500 sq. yds.) —$95.00, freight prepaid.

Prompt shipment is assured. *For complete information, write or wire:*

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EMPIRE STATE CHAPTER

Officers, 1959

Robert Jonas, Vice-Chairman; Harry Porter, Chairman; Iva Van Pelt, Secretary-Treasurer.

Wisconsin Chapter held a "regional meeting" at Pepin, Wisconsin, on June 26. P.L. 566, status of watershed planning and interest of local people in watersheds were discussed by M. F. Schweers, I. O. Hembre, and O. H. Sohrweide. Some of action and planning aspects of the Lost Creek Watershed were covered in a panel discussion. In the afternoon the watershed was toured with H. F. Smith and William Berger leaders. For background reading a two page "Historic notes of the Lake Pepin area" was prepared by Hembre, George Hanson and Marvin Beatty.

Minnesota Chapter had a large contingent at Rapid City. En route, a number of the members visited the Oahe Dam spillway and power house near Pierre, South Dakota. A dinner meeting was held in Pierre on August 24 to hear Sherman W. Williams, assistant area engineer of the Oahe area. On August 25 between Pierre and the Badlands the group viewed conservation practices including many stock-water dams. In the afternoon, the group took a conducted tour of the Badlands National Monument. After this the group went on to Rapid City for a very successful SCSA meeting.

In Minnesota, as is true in a number of other states, the work of the chapter is now being recognized in many quarters. Recently the Minnesota chapter was commended by various national and state political leaders.

A number of the chapter members are at work on Soil Stewardship Days scheduled for September 18 and 19 in Lac qui Parle county. "Terraceville 1959" is the title given this year's event. Among the chapter members active are Jerry Simpson of Marshall, Hector Olson of Madison, Dave Roeske, of Madison, and Oscar Torstenson of Dawson.

Show-Me Chapter (Missouri) held its annual summer picnic at Arrow Rock State Park near Booneville, Missouri, August 9. There were 61 members and guests in attendance. The group heard H. Wayne Pritchard, Executive Secretary of SCSA, talk about national and international soil and water conservation and Society affairs. The chapter is vigorously at work on planning for booklet sales and a greatly increased membership.

Ralph McGil, soil conservationist of Shenandoah, Iowa, formerly located in Missouri, related many of his experiences in the heart of the cornbelt.

North Carolina Chapter used its bi-monthly newsletter in June to present the background of candidates for the chapter officers for 1960. There were also news items concerning individuals, membership status, revision of by-laws, suggested activities, and the work that the chapter had done in entering the activities award contest.

All nine chapters in **Oklahoma** held scheduled meetings this summer. The state meeting of all chapters will be held

Are you "up" on Magnesium?

Soil supplies of magnesium are low in many areas of the U.S. Because, in some places, this shortage is relatively new, you may be overlooking the problem in your area.

What are the danger signs? Why is magnesium important? What is the most complete method for replacement?

The following questions are designed to help you test yourself.

1. A need for magnesium is not always indicated by a magnesium soil test.
   True **False**
2. Magnesium deficiencies are most apparent in.....
   .....
   a. Root Structures **b. Leaves** **c. Stems**
3. Sul-Po-Mag (water soluble magnesium and sulphate of potash) does not change the soil pH.
   True **False**
4. An estimated ..... tons of magnesium are lost into the Mississippi River each year.
   a. 5 thousand **b. 5 million** **c. 5 billion**
5. A high analysis fertilizer decreases the need for magnesium in the fertilizer.
   True **False**
6. Mixed fertilizers containing recommended amounts of Sul-Po-Mag furnish plants with adequate available magnesium.
   True **False**
7. Magnesium acts as a carrier of ..... to the plant.
   a. Calcium **b. Copper** **c. Potassium** **d. Phosphorus**
8. The greatest amount of magnesium is removed from the soil by leaching.
   True **False**
9. Magnesium availability in the soil is not affected by the amount of available calcium.
   True **False**
10. An application of magnesium limestone will not change the pH of the soil.
    True **False**

FOR THE CORRECT ANSWERS turn this ad up-side-down. If you have answered 8 out of 10 questions correctly, you are pretty well informed on Magnesium. If you had trouble, you might be interested in sending for our booklet, "Magnesium."

Answers: 1. T 2. b 3. T 4. b 5. F 6. T 7. d 8. T 9. F 10. F

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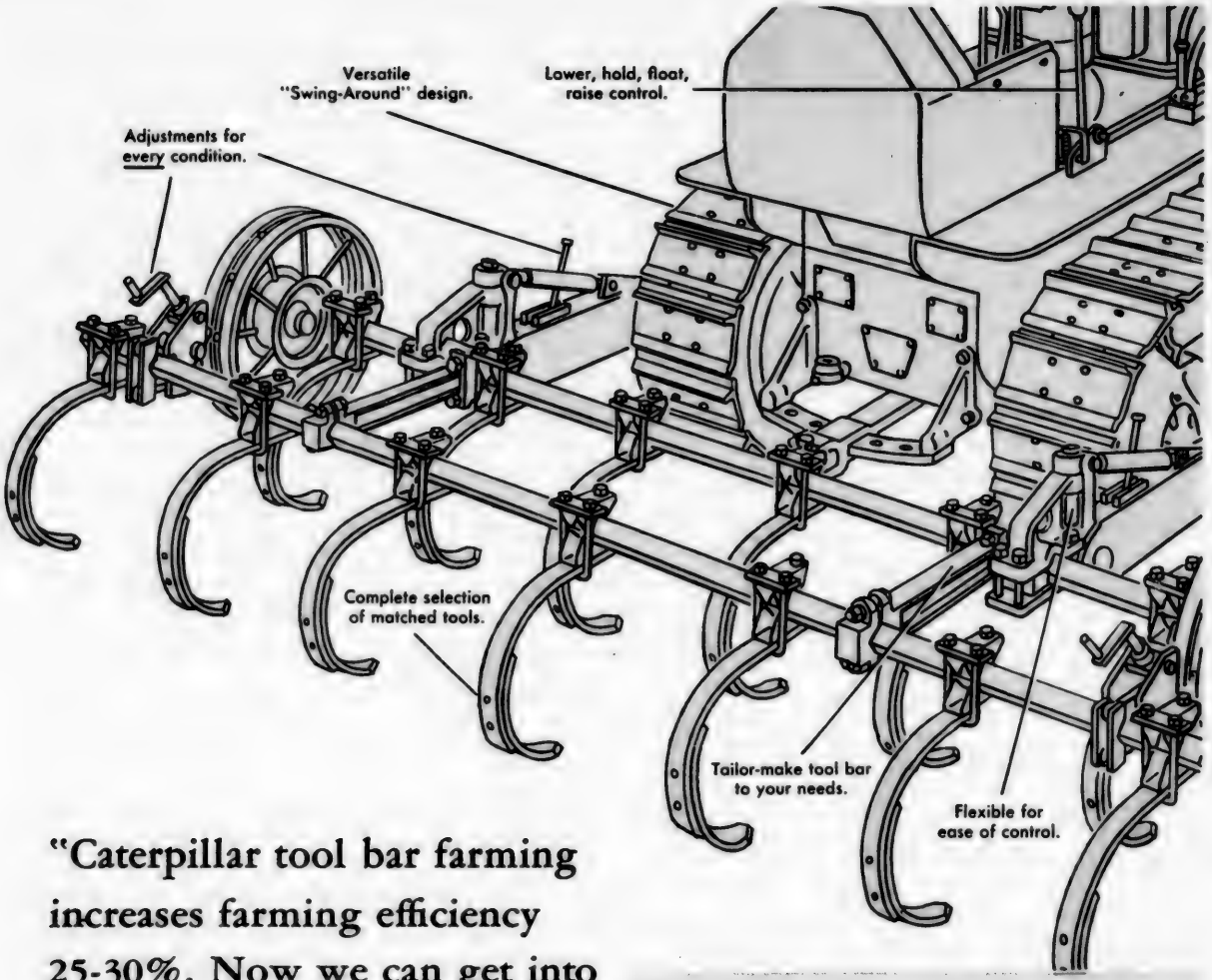
Administrative Center—Skokie, Illinois



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Adrian Bros. D6 with "Swing-Around" No. 6 Tool Bar subsoiling 24" deep. They have owned Caterpillar-built equipment since 1926. "You can't question Cat quality, ease of operation and good dealer service," they report. Tell your dealer you want more facts and a demonstration.

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at Oklahoma State University, October 9 and 10. The theme will be "Soil and Water Conservation Education."

Many of the Oklahoma chapters are engaged in conservation fairs throughout the state. The chapters are cooperating in working out a statewide gully treatment program and an awards program for county agents and agricultural teachers who have presented the best educational programs in soil and water conservation.

Keystone Chapter (Pennsylvania) used the theme, "The Exploding Metropolis," for its annual summer meeting July 31 and August 1 at Potatoe City. The keynote address was given by Francis A. Pitkin, executive director, Pennsylvania state planning board. Pitkin pointed out that Pennsylvania grew 5.7 per cent from 1950 to 1958. Morton Lufgig, Fels Institute of local and state governments at the University of Pennsylvania, discussed "space problems in the space age". He was concerned with what is happening to open lands that supply our food, recreation, and enjoyment. Alvin C. Watson, president of SCSA, did some "crystal ball gazing" in his talk, "Predictions of Things to Come." On Saturday a panel discussion, including the above mentioned speakers and others, enabled the audience to ask many questions. This proved to be an exciting type of meeting and produced some good statements and much thinking. The meeting closed with a color slide talk on Alaska by Dr. Earl Albrecht, deputy secretary of Health, Harrisburg.

The Southern New England Chapter (Massachusetts, Connecticut, and Rhode Island) held its 10th annual summer meeting August 18. The Mohawk Trail State Park was the center of activities. State Biologist Jim Mullan, reported on the reclamation of 40 miles of the Deerfield River. This river is a trout stream and the project is probably the largest reclamation of its kind ever undertaken in the Eastern states. The Yankee Atomic Plant at Rowe, Massachusetts, was visited.

Bud Foster of the Connecticut River Watershed Council was responsible for lining up this fine summer program.

John McCuen, chapter chairman, reminded the members that it pays to advertise. "If you don't advertise," he said "it's like winking at a girl in the dark."

East Tennessee Chapter suspended its monthly meetings for the summer, but committees planning for fall meetings were at work. The three sub-chapters, Upper Valley, Chattanooga and Knoxville meet separately with one all-chapter meeting annually.

Inland Empire Chapter (Washington and Idaho) held a very successful 5-day camp on water and soil with 37 high school youths from 35 districts attending. Superintendent of the camp was Harold Boeger of Dayton; camp treasurer was Art Sunderland, Columbia county extension agent. Almost all aspects of soil and water conservation were touched on in lectures and field trips. The chapter plans to hold another camp in 1960.

At the Inland Empire chapter youth camp, time out for an informal discussion on soils. *L-R:* campers Randy Darling and Paul Brown (Benewah SCD in Idaho); Harold Boeger (instructor) WUC, SCS, Dayton, Wash.; camper Perry McCoy (East Benton SCD, Wash.); camper Dan Downs (West Franklin SCD, Wash.); Warren Starr (instructor), professor of soils, Washington State University, Pullman, Wash.; and Tom Templeton, (Chapter chairman), KHQ radio and TV station farm director, Spokane, Wash.

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BEST BUYS IN NEW AND USED EQUIPMENT

(Chapter News continued)

South Carolina Chapter prepared an active program to promote the commemorative soil conservation stamp in late August. They produced a 15 minute program given on WIS-TV in Columbia, and covered the state well with news releases.

J. T. McAlister of Orangeburg is chapter chairman for 1960.

Florida Chapter at its annual meeting recognized a number of "mass communication" media by specific awards. The chapter gave awards to radio station WRUF in Gainesville; television station WFLA-TV in Tampa; and the newspaper Jefferson County Floridan in Marianna. Through such recognition the good work these mass communication media are doing in conservation is put on the map.

NEW SCS DEVELOPMENT . . .

WASHED OUT!

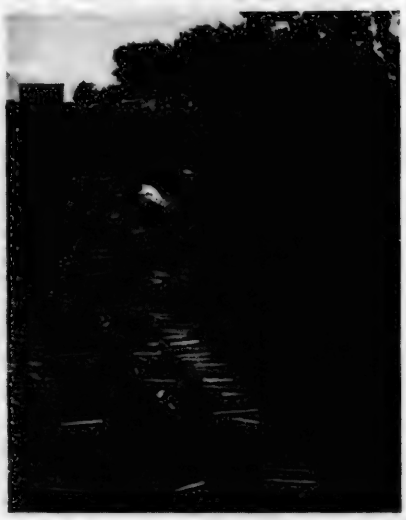
STABILIZED!

THE DIFFERENCE!

Rains continually washed out this critical waterway on a Maryland farm. Graded and seeded again, this same waterway was soon subjected to heavy downpour. But, this time, the waterway held! THE DIFFERENCE — an idea conceived and developed by Soil Conservation Service technicians: *the use of jute thatching to stabilize critical waterways while grass takes over.*

Write for facts about this new method of stabilizing waterways.

See Journal of Soil and Water Conservation, May '59, pgs. 117-119. "Jute for Waterways"; R. V. D. Broach, C. S. Slater, M. T. Augustine, and E. E. Evaul.



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NEWS OF MEMBERS

Members of the Empire State (New York) chapter who have been active in educational and Boy Scout activities are **Claire Herting, John Porter, Ted Hebel, Ralph Work,** and **Howard Boggs. Earl Douglas** helped make a film for radio station WRGB in Schenectady. The film shows the advantages of contour versus "downhill" tillage.

Members of the SCSA serving on the Wisconsin Conservation Education Committee of State Agencies, established by chapter 203 of the laws of 1951 of the Wisconsin Statutes, are **Dr. I. L. Baldwin,** chairman, **I. O. Hembre, Henry Kolka,** Eau Claire State College, and **W. W. Russell,** USDA, SCS, Madison.

Richard M. Dailey, of Raleigh, North Carolina, was named state conservationist for the USDA's Soil Conservation Service in North Carolina. He assumed his position Aug. 31 and succeeds **Earl B. Garrett,** who retired after 28 years service in the Department.

Harold L. Dean, head of the Fort Worth Cartographic Unit of the SCS, recently received a certificate of achievement from the Fort Worth Federal Business Association for his outstanding contribution to the federal service for 1959.

Although the Soil Conservation Society of America was not officially represented at the *Symposium on the Economics of Watershed Planning,* held June 10-12, 1959, at Knoxville, Tennessee, nevertheless there were many members of the Society present. Among those present were **Lawrence S. Hamilton, Ayers Brinser, Lyle E. Craine, Gil Banner, Fred Clarenbach, Raymond J. Penn, M. L. Weinberger, L. L. Kelly, Joseph Ackerman, H. E. Hecker, Vernon F. Maresch, E. C. Buie, E. F. Carmichael, J. E. McLean, Max J. Edwards, William E. Hall, Abe Hart, Horace Holman, J. Ralph Sasser, E. C. Ford, Gladwin E. Young, Melville Cohee, Vedene Smith, Albert Spector, Bart Smith, E. L. Baum, Kenneth J. Seigworth, E. H. Lesesne, Barbara Seehorn, Willard M. Snyder, Bernard H. Zellner, A. B. Rogers,** and **Ray Sims.**

Robert D. Flannery is listed now as land reclamationist with an engineering outfit located in Adana, Turkey. He is currently in charge of the reclamation and drainage investigations on the 500,000 acre Adana Plain on the south coast of Turkey.

Myren Grimes of the Minnesota chapter has completed his class work on his Master's Degree in soils and has returned to St. Cloud to continue his duties as a soil scientist.

C. Dale Jaedicke, who has been serving as deputy state conservationist in North Dakota for the past three and one-half years, succeeds H. G. Bobst as state conservationist for the SCS in Nebraska. Bobst has moved to Washington, D. C., to serve as the SCS's field representative for the Great Plains.

Edward R. Keil will succeed **Edward M. Davis** as Maryland State Conservationist. Keil has been New York Deputy State Conservationist since 1955. Davis is transferring to the ICA to head up the program of soil and water conservation help in India.

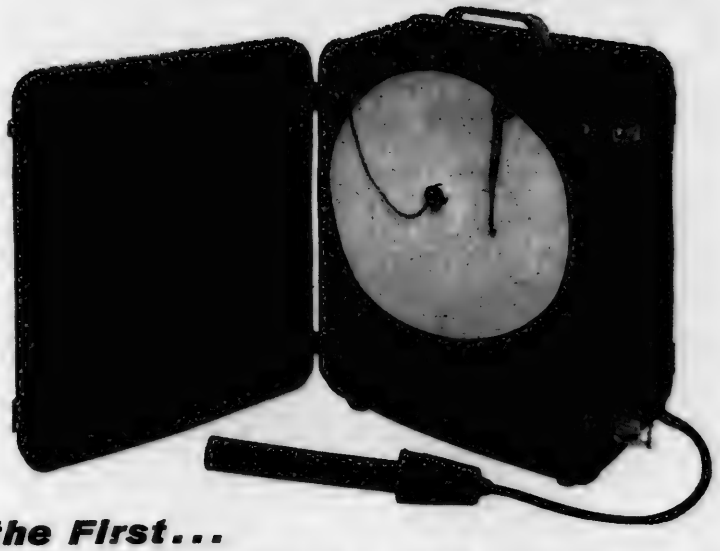
Steven J. Kortan, Kansas deputy state conservationist, became the state conservationist in South Dakota on August 1. Kortan is a native South Dakotan and a 1933 graduate of South Dakota State College. He is a charter member of the SCSA.

William H. Kricher, of Minneapolis, Minnesota, has been named editor-in-chief of the Farmer magazine, moving up from managing editor.

Al Laidlaw, area conservationist in the Green Bay area of Wisconsin, has been appointed assistant state conservationist in Minnesota. Succeeding Laidlaw as area conservationist at Green Bay is **Randy Briggs,** another member of the SCSA.

George Moore, of New York state, has had a long service of conservation broadcasts over radio station WGVA. He handled many conservation programs from July 1947 to April 1959.

Austin L. Patrick, Field Representative of the USDA, SCS, for the cornbelt, retired August 31. "Pat" has had more than 32 years service with the USDA.



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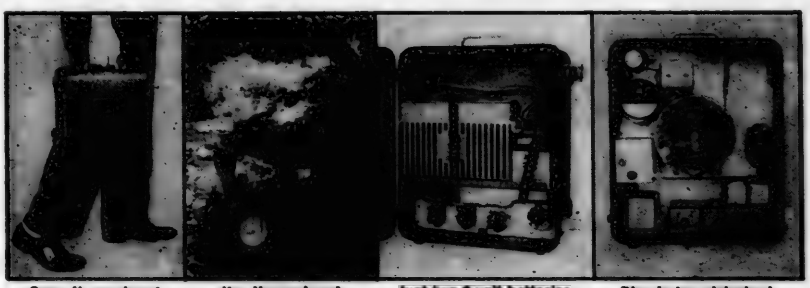
Utilizing a clock-work mechanism for the chart drive, no electrical power is consumed. All electronic portions of the recorder are completely transistorized minimizing battery drain over existing conventional units. The recorder is manufactured in a circular chart model only with a wide range of chart speeds available. AC Wheatstone bridge self-balancing principle has been incorporated into the recorder with a bridge frequency of 1000 cps.

Unique circuitry keeps the current drawn from the batteries to a figure of less than 8.0 ma when the instrument is not rebalancing and approximately 600 ma when rebalancing. Two 6 volt batteries are supplied with the instrument and are sufficient for two months of continuous operation. Numerous battery packs can be supplied in both the dry cell and rechargeable types.

The recorder is direct reading in micromhos and is available in a wide variety of ranges. Measurements of electrolytes ranging from distilled water to strong acids can be made. Can be supplied with either manual or automatic temperature compensation. Unit is housed in handsome, drawn aluminum carrying case with handle. Case is gasketed and of splash-proof construction. Size: 13⅞" high X 11⅜" wide and 9½" deep. Weight 18 (without batteries).



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SCALES • COMPRESSORS • GENERATORS • MAGNETOS • HOME WATER SYSTEMS

Val W. Silkett has been named by SCS administrator Don Williams to succeed Austin L. Patrick as cornbelt field representative. Silkett is currently serving as head of farm and ranch planning work in the Washington office. He has served on the SCS staff since 1936 and for five years was assistant state conservationist in Iowa.

Mrs. Hester Underhill, a member of the Southern New England SCSA chapter, has participated in the summer institute of field biology and ecology at the University of Rhode Island under the sponsorship of the National Science Foundation.

Alvin C. Watson, northeastern river-basin representative of the Soil Conservation Service, has been elected chairman of the Northeastern Resources Committee for the coming year, effective July 1. This Committee is made up of representatives of the governors of the six New England States, plus a representative from each of the seven major federal departments with resource programs in New England (agriculture, interior, labor, commerce, army, health, education and welfare, and the federal power commission). The Committee operates under a charter from the Interagency Committee on Water Resources and coordinates activities of the agencies and the states in the water resources field.

—SCSA—

NECROLOGY

S. N. Boyd, Soil Conservation Service, Ripley, Mississippi, died July 15, 1959.

Richard M. May, deputy state conservationist of Connecticut, died on June 21, 1959. Dick was well-known as an ardent conservationist and was willing to help promote conservation at every turn.

Clay H. Stackhouse, a leader of various Ohio farm committees and an Agriculture Department official in Washington, D. C., died July 19. He was a member of the Washington, D. C., No. 1 chapter.

The death of **William C. Higgins,** of Statesboro, Georgia, and **Winston C. White,** of Lumpkin, Georgia, has been reported at the SCSA office.

LIBRARY FOR CONSERVATIONISTS

A LIST of soil and water conservation publications rated highly by a selected group of conservationists and publishers was made in 1958 by the editorial office of the Soil Conservation Society of America. Out of 150 form solicitations distributed nationwide, 80 returns were received. Respondents included state conservationists and regional biologists of the Soil Conservation Service, professors, members of the JOURNAL editorial board, leaders of various conservation agencies and organizations and publishing companies.

Each recipient was asked to list not more than ten books or other publications considered outstanding and influential, with emphasis on soil and water conservation. In all, 226 titles (most are recently printed) were listed. Below, in alphabetical order, are those publications which received four or more mentions. (*Water*—USDA 1955 Yearbook received 24.)

This "study" was not a contest, but was an attempt to find out what publications conservation workers had read and considered worthy. If you are interested in purchasing any of these books, please see your local book dealers or write the publishing company. Mention the JOURNAL.

How many of these publications have you read? What would you add to this library?

1. Allen, Durward. *Our Wildlife Legacy.* (Funk & Wagnalls, 1954.)
2. Allen, Shirley W. *Conserving Natural Resources.* (McGraw-Hill, 1955.)
3. Bennett, H. H. *Elements of Soil Conservation.* (McGraw-Hill, 1947.)
4. Bennett, H. H. *Soil Conservation.* (McGraw-Hill, 1939. Also later edition.)
5. Callison, Charles H. *America's Natural Resources.* (Ronald Press, 1957.)
6. Carter, Vernon and Tom Dale. *Topsoil and Civilization.* (Oklahoma Univ. Press, 1955.)
7. Chase, Stuart. *Rich Land, Poor Land.* (McGraw-Hill, 1936.)
8. Colman, Edward A. *Vegetation and Watershed Management.* (Ronald Press, 1953.)
9. Coyle, David C. *Conservation: An American Story of Conflict and Accomplishment.* (Rutgers, 1957.)
10. Foster, A. B. *Approved Practices in Soil Conservation.* (Interstate, 1955.)
11. Frank, Bernard and Anthony Netboy. *Water, Land and People.* (Knopf, 1950.)
12. Frevert, R. K., et al. *Soil and Water Conservation Engineering.* (Wiley, 1955.)
13. Graham, Edward H. *Natural Principles of Land Use.* (Oxford, 1944.)
14. Graham, Edward H. and William R. Van Dersal. *Water for America.* (Oxford, 1956.)
15. Higbee, Edward. *The American Oasis.* (Knopf, 1957.)
16. Hoyt, William G. and Walter B. Langbein. *Floods.* (Princeton, 1955.)
17. Jack, G. V. and R. O. Whyte. *Vanishing Lands.* (Doubleday, 1939.)
18. Leopold, Aldo. *A Sand County Almanac.* (Oxford, 1949.)
19. Leopold, Luna B. and Thomas Maddock, Jr. *Flood Control Controversy.* (Ronald, 1954.)
20. Lord, Russell. *Behold Our Land.* (Houghton Mifflin, 1938.)
21. Mickey, Karl B. *Man and the Soil.* (International Harvester, 1945.)
22. Osborn, Fairfield. *Our Plundered Planet.* (Little, Brown & Co., 1948.)
23. Parks, Robert. *Soil Conservation Districts in Action.* (Iowa State College, 1952.)
24. Parson, Ruben L. *Conserving American Resources.* (Prentice-Hall, 1956.)
25. Russell, E. J. *Soil Conditions and Plant Growth.* (Longmans Green & Co., 1950.)
26. Soil Conservation Society of America. *Journal of Soil and Water Conservation.* (Soil Conservation Society, 1946—.)
27. Sears, Paul B. *Deserts on the March.* (University of Oklahoma, 1935.)
28. Shepard, Ward. *Food or Famine: The Challenge of Erosion.* (Macmillan, 1945.)
29. Stallings, J. H. *Soil Conservation.* (Prentice-Hall, 1957.)
30. Storer, John. *The Web of Life.* (Devin-Adair Co., 1953.)
31. Thomas, William L. (editor). *Man's Role in Changing the Face of the Earth.* (University of Chicago Press, 1956.)
32. USDA. *A Manual on Conservation of Soil and Water: Soil Conservation Service Agricultural Handbook No. 61.* (U. S. Supt. of Documents, 1954.)
33. USDA. *Climate and Man*—1941 Yearbook of Agriculture. (U. S. Supt of Documents.)
34. USDA. *Grass*—1948 Yearbook of Agriculture. (U. S. Supt. of Documents.)
35. USDA. *Land*—1958 Yearbook of Agriculture. (U. S. Supt. of Documents.)
36. USDA. *Soil*—1957 Yearbook of Agriculture. (U. S. Supt. of Documents.)
37. USDA. *Soils and Men*—1938 Yearbook of Agriculture. (U. S. Supt. of Documents.)
38. USDA. *Trees*—The 1949 Yearbook of Agriculture. (U. S. Supt of Documents.)
39. USDA. *Water*—The 1955 Yearbook of Agriculture. (U. S. Supt. of Documents.)
40. Vogt, William. *The Road to Survival.* (Wm. Sloan Associates, 1948.)

Publishers

Devin-Adair Publishing Co.
23 East 26th St.
New York 10, N. Y.

Doubleday & Co.
Garden City, New York

Funk & Wagnalls
153 East 24th St.
New York 10, N. Y.

Houghton-Mifflin Co.
2 Park St.
Boston 7, Massachusetts

International Harvester Co.
180 N. Michigan Ave.
Chicago 1, Illinois

Interstate Publishing Co.
19 N. Jackson St.
Danville, Illinois

Iowa State College Press
Ames, Iowa

Alfred A. Knopf Co.
501 Madison Ave.
New York 22, N. Y.

Little, Brown & Co.
34 Beacon St.
Boston 6, Massachusetts

Longmans Green & Co., Ltd.
6 Clifford St.
London W-1, England

McGraw-Hill Book Co.
330 W. 42nd St.
New York 36, N.Y.

Macmillan Co.
60 Fifth Ave.
New York 11, N. Y.

Oklahoma University Press
Norman, Oklahoma

Oxford University Press
417 Fifth Ave.
New York 16, N. Y.

Prentice Hall, Inc.
70 Fifth Avenue
New York 11, N. Y.

Princeton University Press
Princeton, New Jersey

Ronald Press Company
15 East 26th St.
New York 10, N. Y.

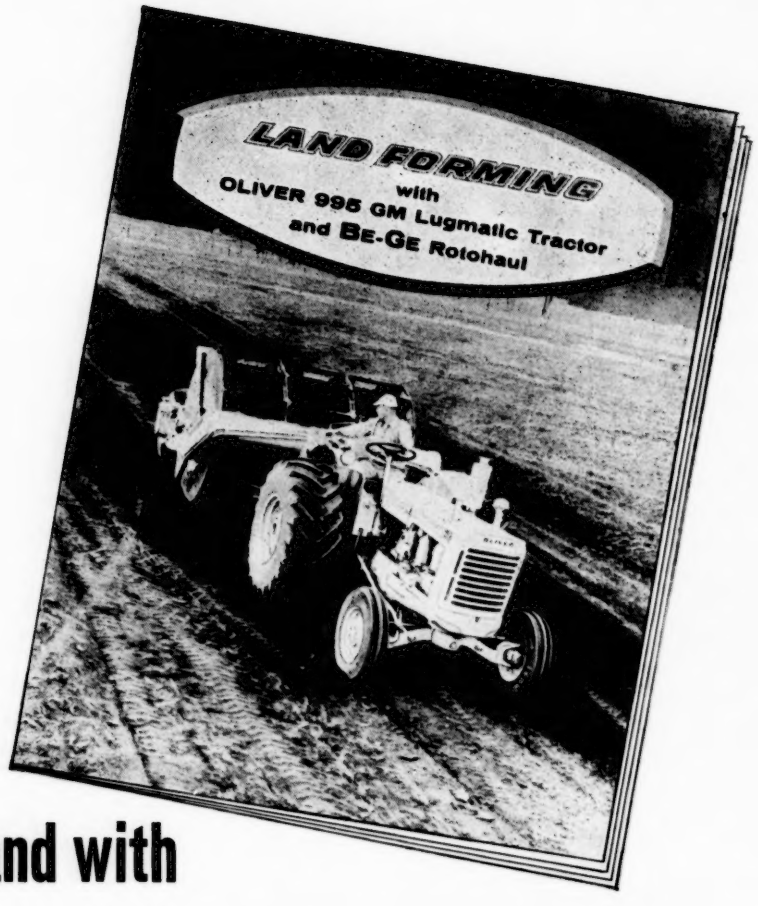
Rutgers University Press
New Brunswick, New Jersey

William Sloane Associates
425 Fourth Ave.
New York 16, N. Y.

U. S. Superintendent of Documents
Government Printing Office
Washington 25, D. C.

University of Chicago Press
5750 Ellis Ave.
Chicago 27, Illinois

John Wiley & Sons, Inc.
440 Fourth Ave.
New York 16, N. Y.



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